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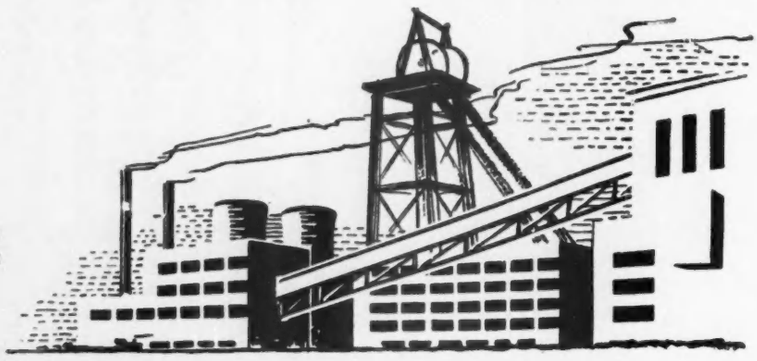

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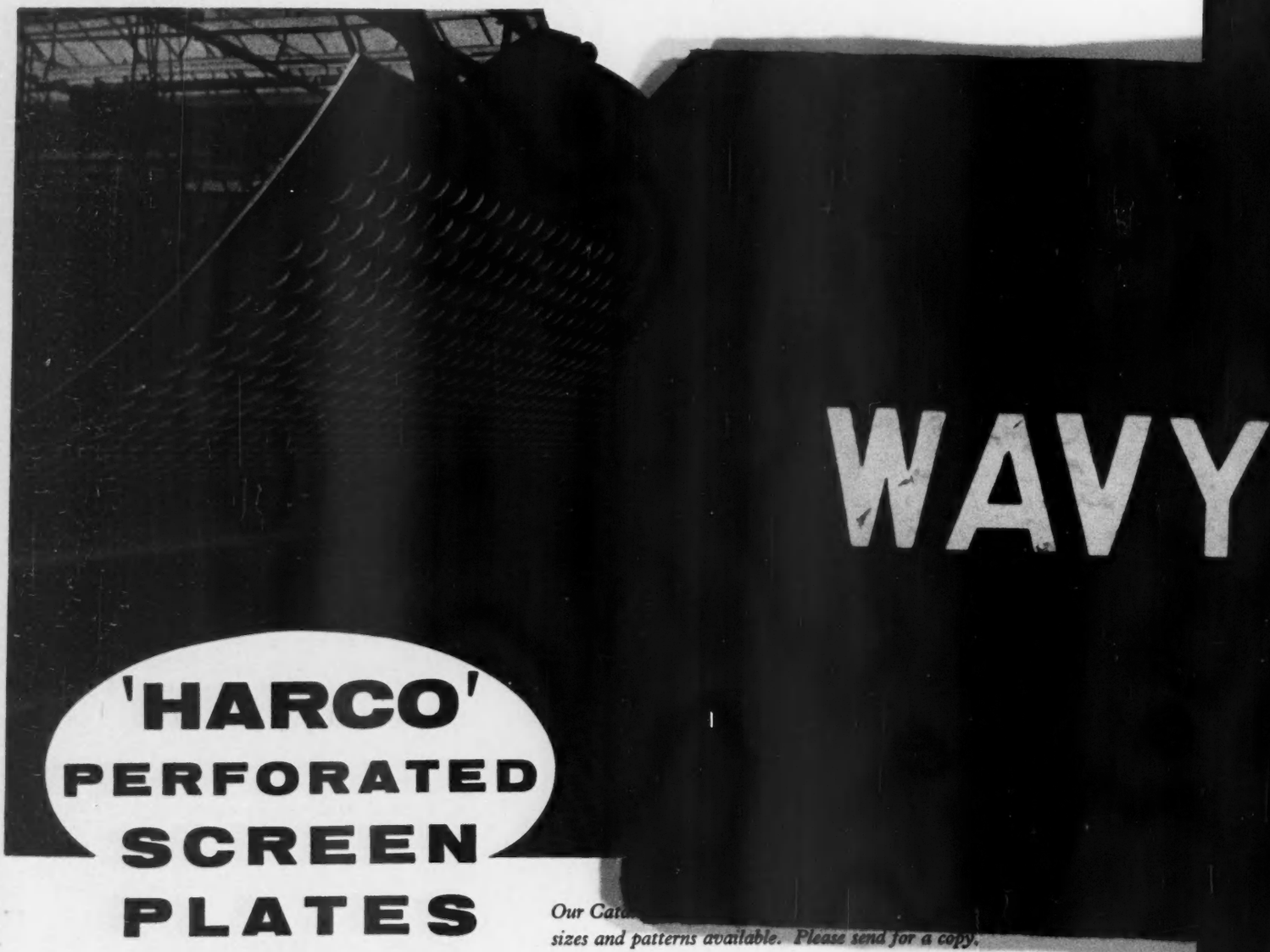

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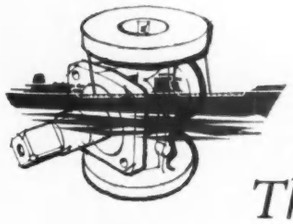

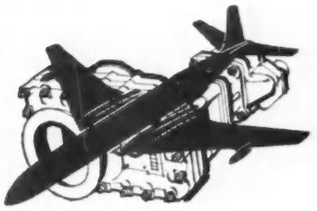

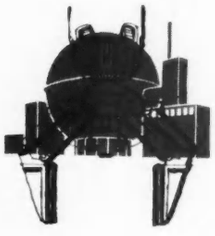

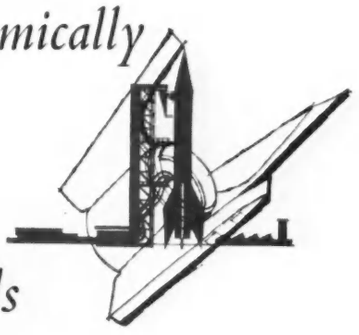

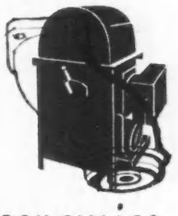

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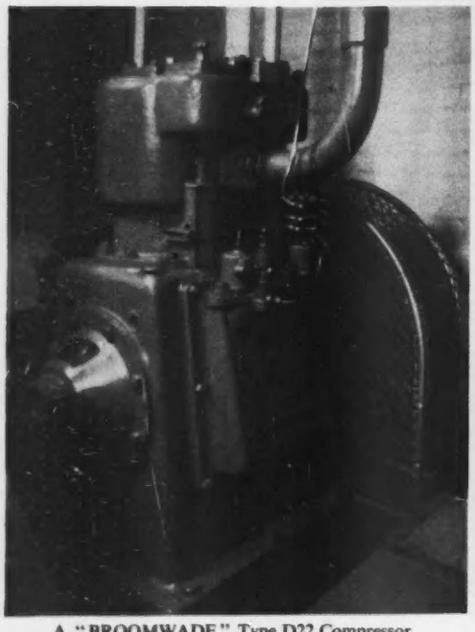

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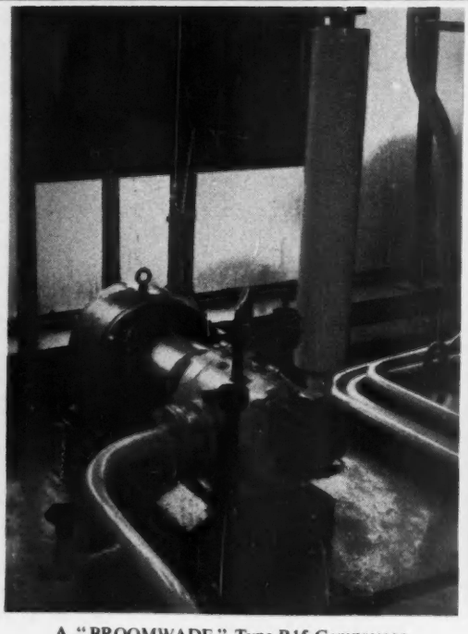
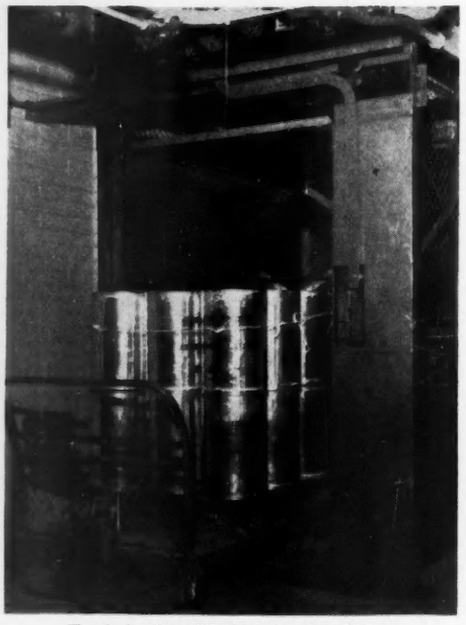


A "BROOMWADE" Type R15 Compressor installed in the boiler house at Chadwell Heath to atomise fuel for the oil-fed boilers.



Trucks leaving a lift through gates which are opened and closed by compressed air.

Photographs by courtesy of Messrs. Lewis Berger (Great Britain) Ltd.

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In the development of a fuel system for engines for supersonic aircraft, the ambient temperatures under which they will be operating (probably 250° C) must be simulated to ensure mechanical and functional reliability. The high ambient temperature is attained by lowering a metal canopy in which infra-red quartz tube elements are incorporated to encase the complete fuel system.
(*Nurnberg photograph for* ENGINEERING)

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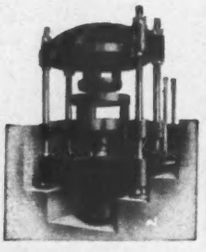

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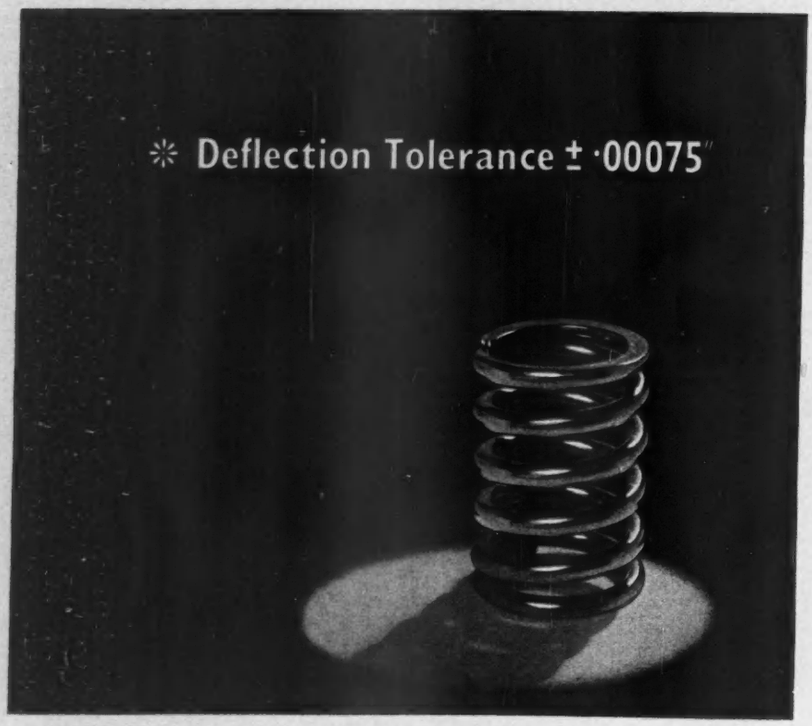

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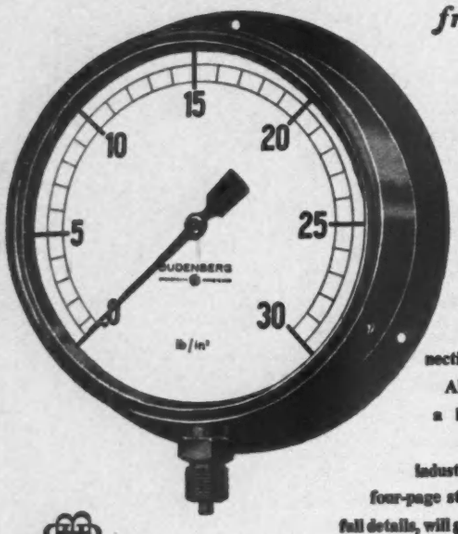

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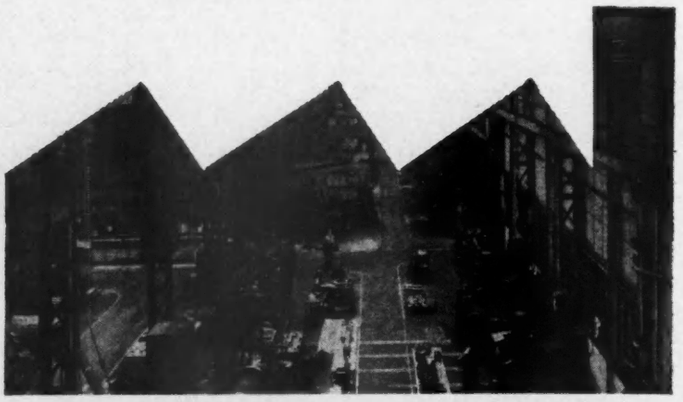

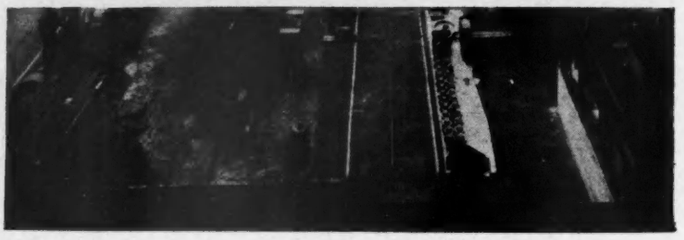

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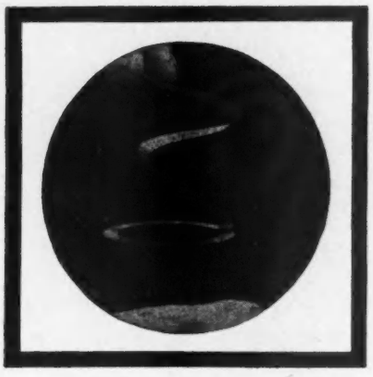

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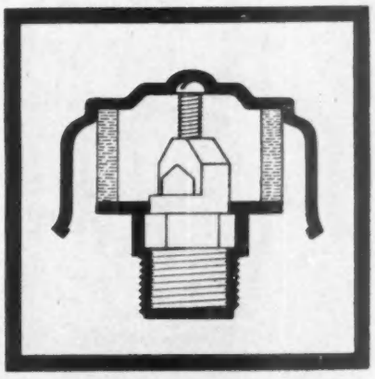

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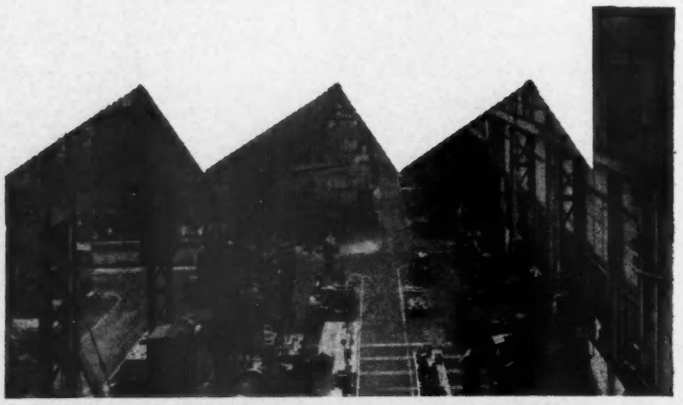

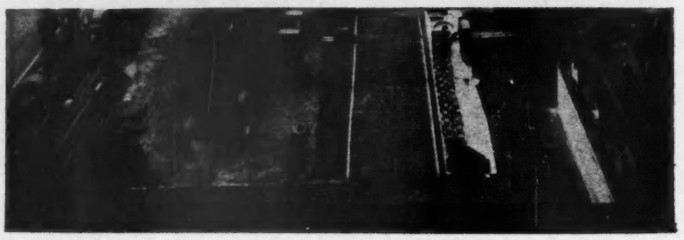

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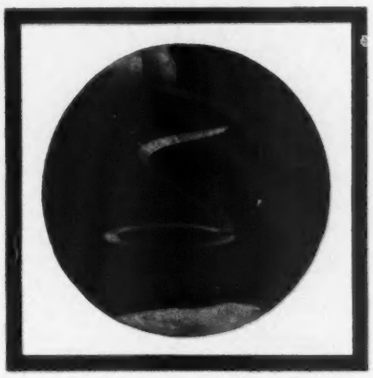

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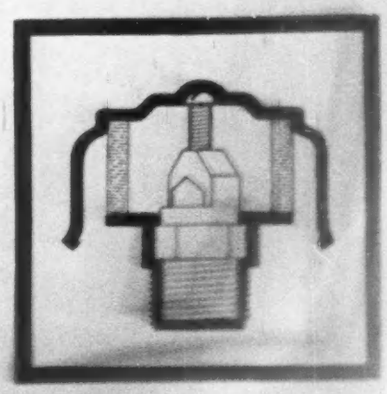

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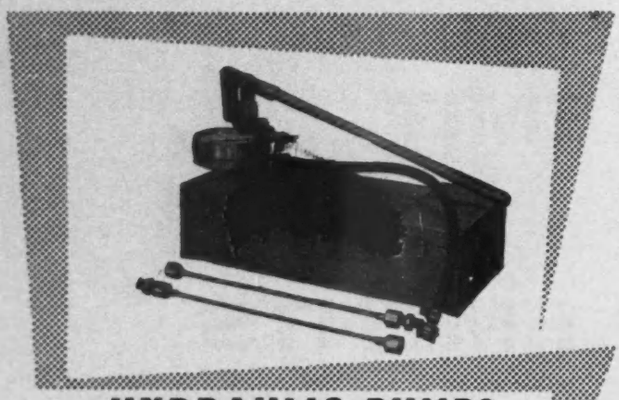

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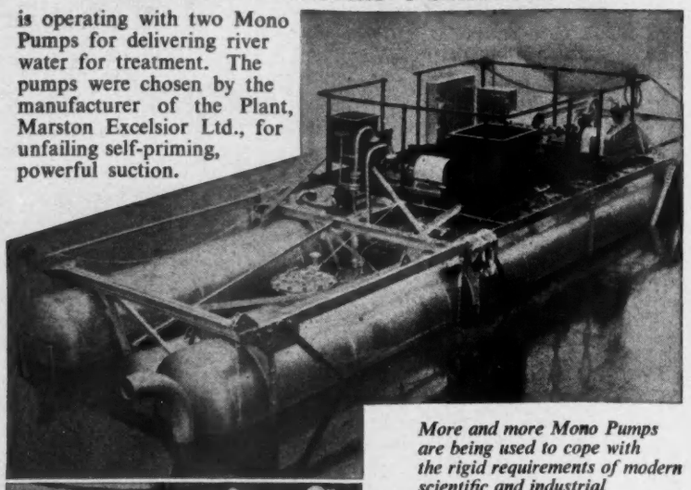

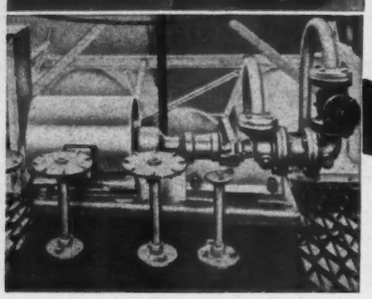

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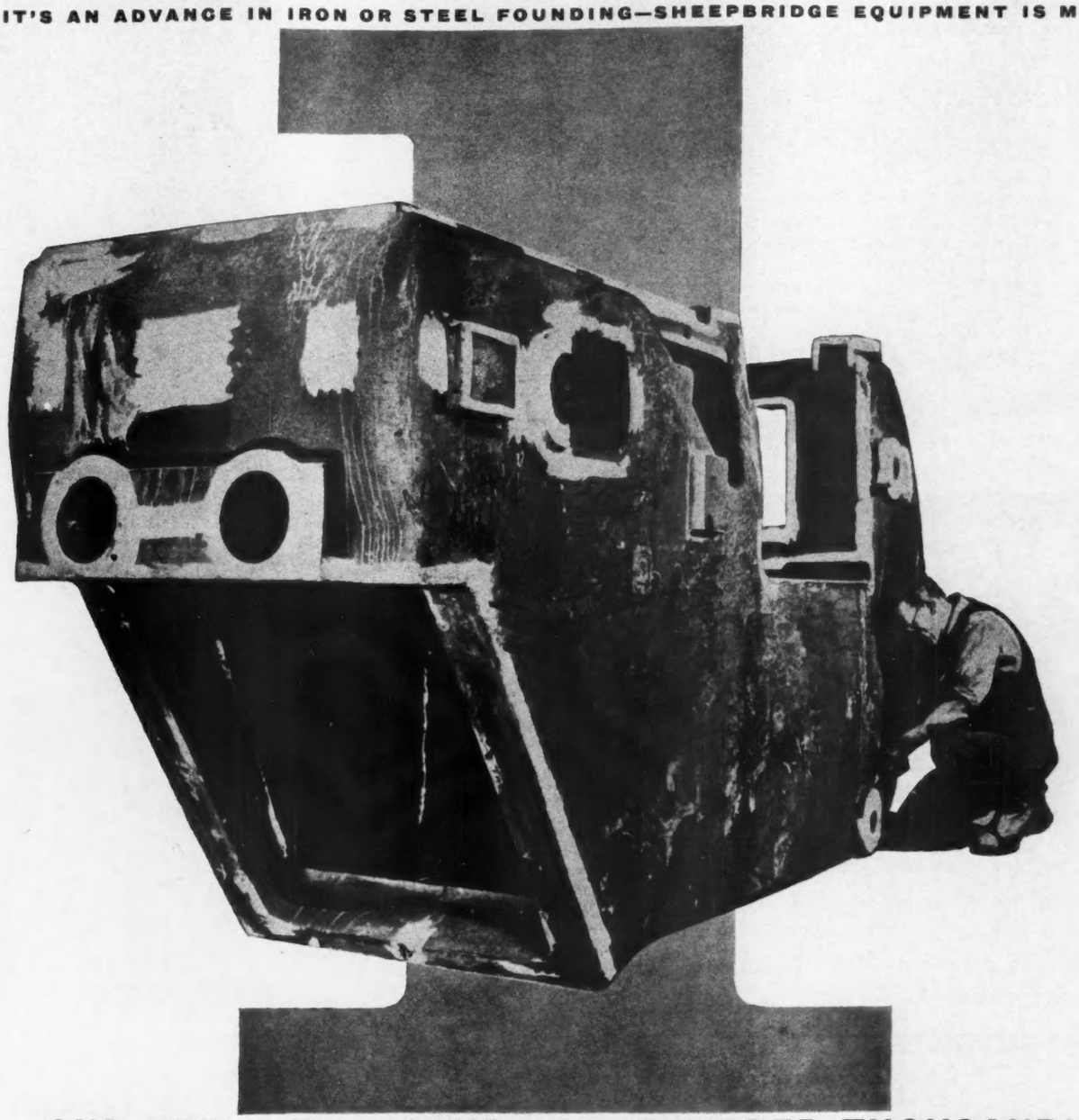

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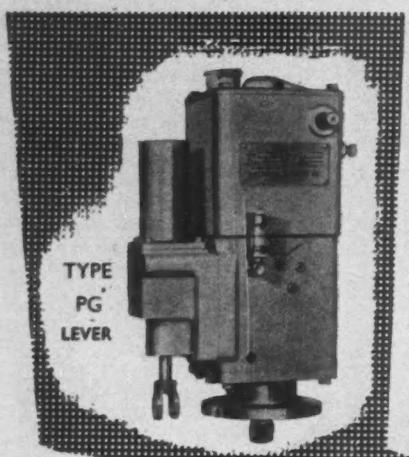
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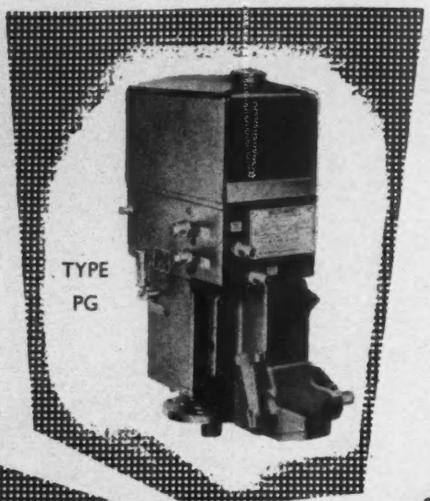
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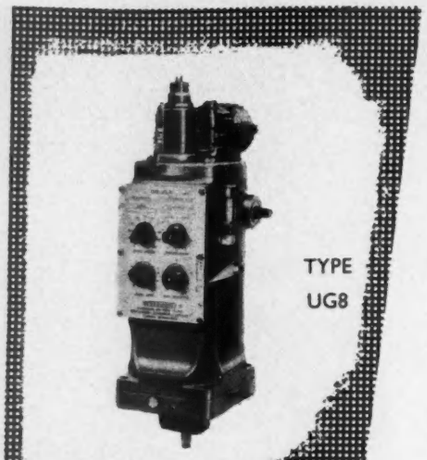
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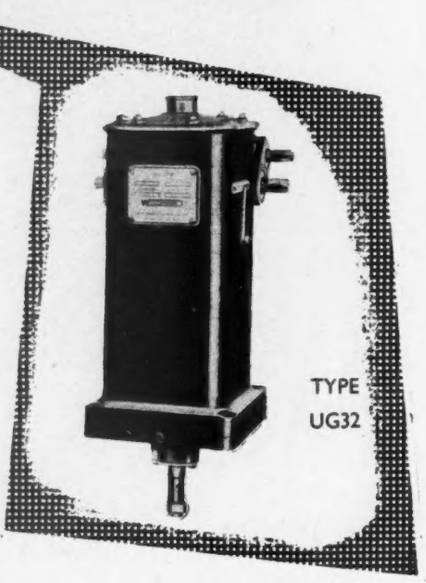
TYPE UG32

RATED WORK CAPACITY		TYPE SPEED ADJUSTMENT
SG	1 or 2 ft./lb.	MANUAL, LEVER OR ELECTRIC
PSG	2.6 ft./lb.	MANUAL, LEVER OR ELECTRIC
LSG	1 or 10 ft./lb.	MANUAL OR ELECTRIC
UG8	8 ft./lb.	MANUAL, LEVER OR ELECTRIC
UG32	32 or 40 ft./lb.	MANUAL, LEVER OR ELECTRIC
PG	12/18 or 35 ft./lb.	MANUAL, LEVER OR ELECTRIC
PG for RR	12 or 35 ft./lb.	ELECTRIC OR PNEUMATIC
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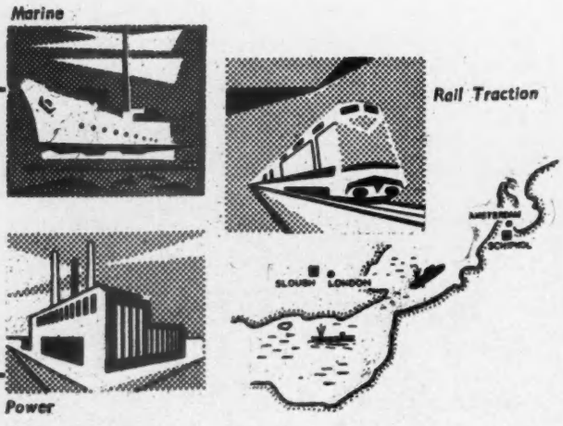

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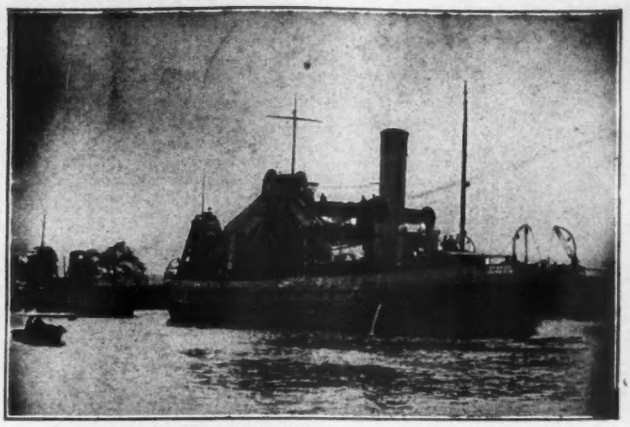

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Speed loaded: 9½ knots Dredging capacity per hour: 1,000 tons

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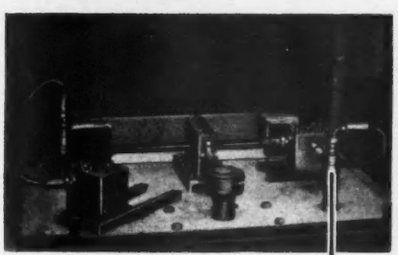
The NEW QUICK RELEASE coupling..



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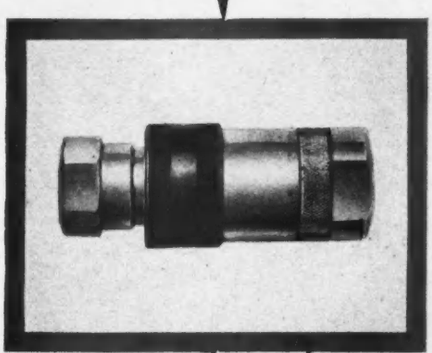
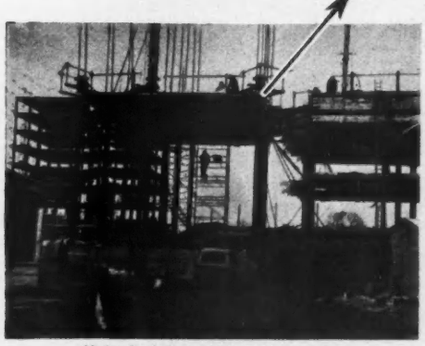
Golden flow

A NEW CONCEPTION OF HOSELINE MOBILITY

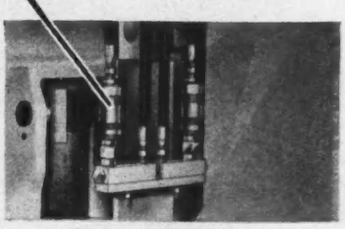
SAVES TIME, MONEY AND TROUBLE

In the past, the only method of connecting Hydraulic feed lines was by screw fittings. Now, with the advent of Golden Flow Couplings, recently introduced by us, a completely efficient connection is achieved simply by pushing the two halves of the coupling together. Disconnection is effected by pulling them apart. Furthermore, on disconnection each coupling half is automatically sealed by the poppet valve, so preventing the loss of valuable hydraulic fluid. By using a break-away bracket, one half of the coupling is held permanently in place, so that in the event of an unexpected strain on the feed line, the coupling automatically breaks away, without damage to hoseline or equipment.





Hydraulic Jack on Building Construction



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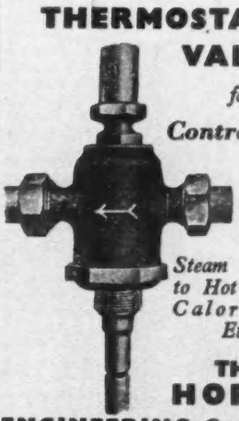

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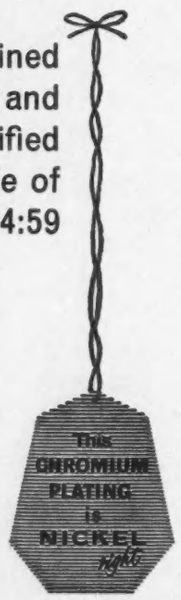

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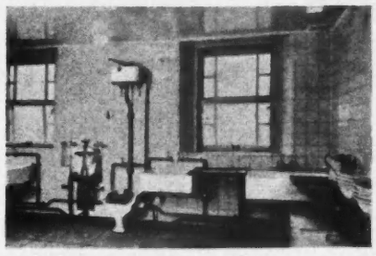
Use the famous RAWLPLUG for neat, firm fixings in brick, stone, etc. All sizes for up to ½in. diameter Coach Screws. Rawlplugs are waterproofed and unaffected by climatic conditions.



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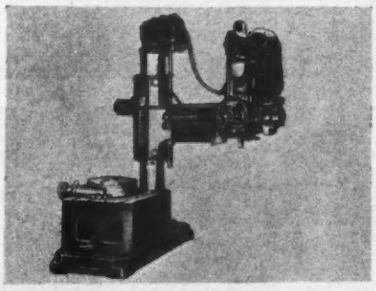
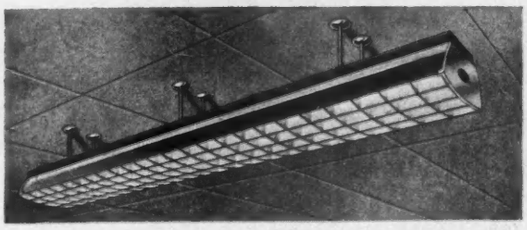
For bolting down machines, light or heavy, use RAWLBOLTS, a *dry* fixing that grips by expansion. No cold chiselling, no waiting for cement to harden. Sizes up to 1in. bolt diameter.





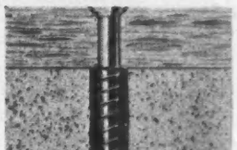
CAVITY FIXINGS The amazing RAWLNUT, screwed up from the front, forms its own rivet head *behind* the material—airtight, water-tight, vibration-proof, squeak-proof! For all thin or hollow materials.

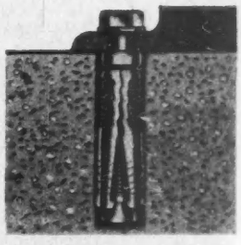
Rawlplug fixing devices save you time and money

Fixing methods that served well enough in by-gone days fall far short of modern standards of efficiency, when an average machine can be safely bolted down *and in operation* within an hour or so of arrival!

Rawlplug Fixing Devices always save time and therefore money, for it is a simple *fact* that on *every* screw and bolt fixing job, in solid *or* cavity materials, you'll make strong, absolutely safe fixings in *far less time than by any other method.*

You can easily prove this for yourself. The first step is to write for full details of the 24 different types of Rawlplug Fixing Device. Write us now—and if, after studying our literature, you have any difficulties about a particular problem, our Technical Service specialists will be delighted to advise you without obligation.





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FIXING DEVICES
THE RAWLPLUG COMPANY LTD.
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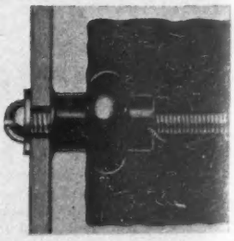
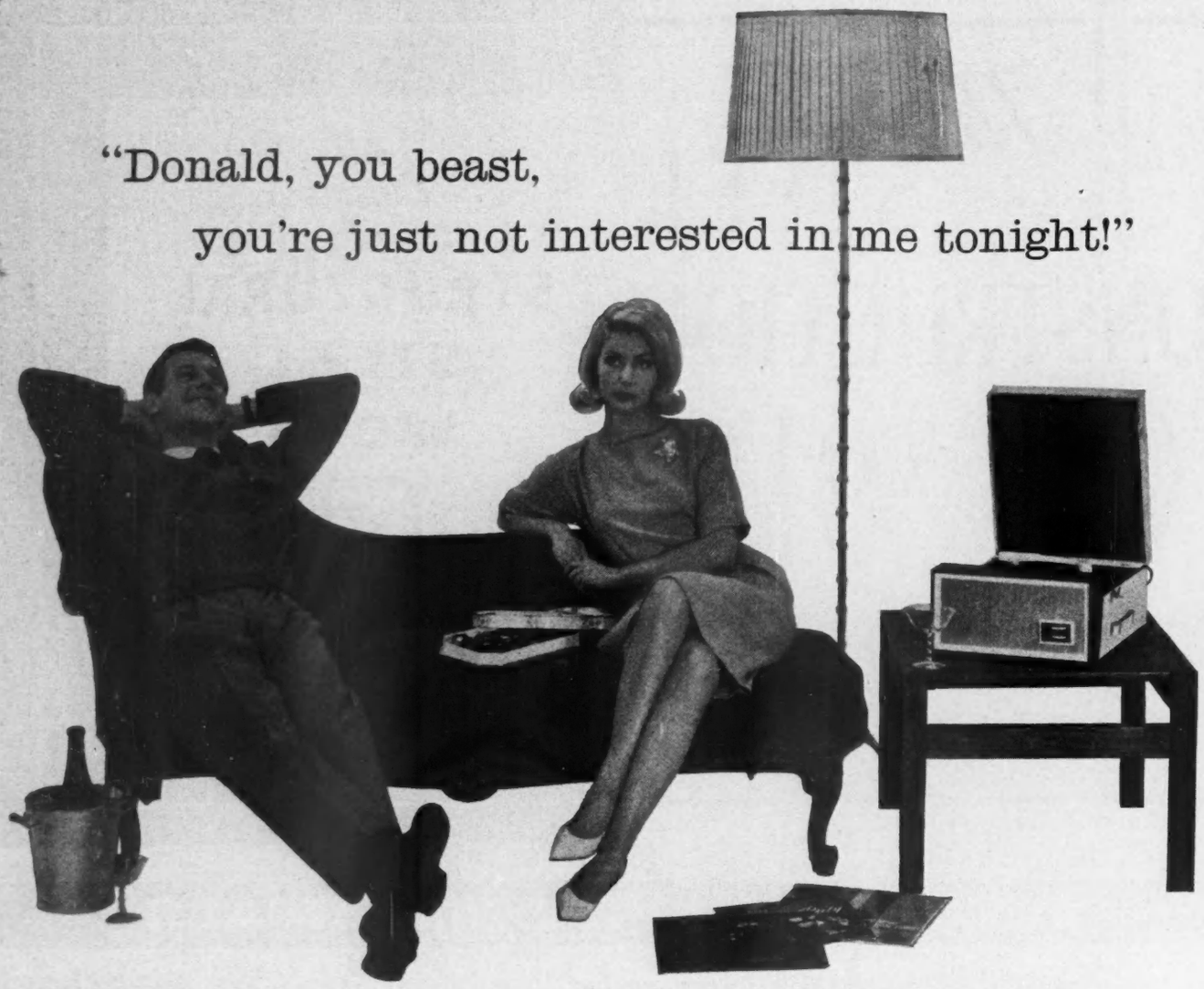


"Donald, you beast, you're just not interested in me tonight!"



"Sorry, Daphne, but something wonderful happened to-day. I discovered G.D. cone lock pipe-stoppers."

"Cone lock *whats*?"

"Pipe-stoppers, darling. Made by General Descaling. We've always needed something for bunging up open pipe-ends for pressure testing, and these tools are just the job . . . . . ."

"I'm sure you're terribly pleased . . . . . ."

". . . . . and they're *so* simple to use! Just pop one in the pipe—anything from 3" - 14" diameter—give the wing nut a couple of turns, and let the pressure do the rest. The bigger the squeeze, the tighter the stopper. It's the expanding vice ring that does it, you see. The lads are *mad* about G.D. cone locks!"

"That's nice for their girl-friends."

"They'll stand up to 2,000 lb. per square inch! And think of the other advantages—no more welding up bullplugs, blanks, connections or burning off afterwards. And they have a removable plug so we can fit pressure gauge connections. We can fit or remove them in a jiffy. They're re-usable, too—and that's *very* important when you're . . . . . ."

"I knew it. I should have invited Jim instead. He's in insurance!"

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'Arcon' storage building supplied by Taylor Woodrow (Building Exports) Ltd., to the State Tobacco Monopoly, Tripoli, Libya, in which Opal Corrugated 'Perspex' has been used for roof lighting, to give a diffused light to the interior.

Opal Corrugated 'Perspex' roof lighting provides ideal working light in a Tripoli Tobacco store

FOR THE PROPER care of the tobacco in this storehouse, good lighting was essential. This was achieved by installing Opal Corrugated 'Perspex' acrylic sheet in the roof.

Opal Corrugated 'Perspex' transmits an evenly diffused working light. It is inexpensive to install and saves money on artificial lighting. It is light, tough, easy to handle, is unaffected by the severest weather conditions, and withstands the corrosive atmospheres of industrial and marine areas.

Clear corrugated 'Perspex' is sold for roof lighting where strong sunlight is not a problem. Corrugated 'Perspex' is available in a wide range of profiles to fit most corrugated roofing materials.

For good roof lighting use

CORRUGATED 'PERSPEX'

'Perspex' is the registered trade mark for the acrylic sheet manufactured by I.C.I.

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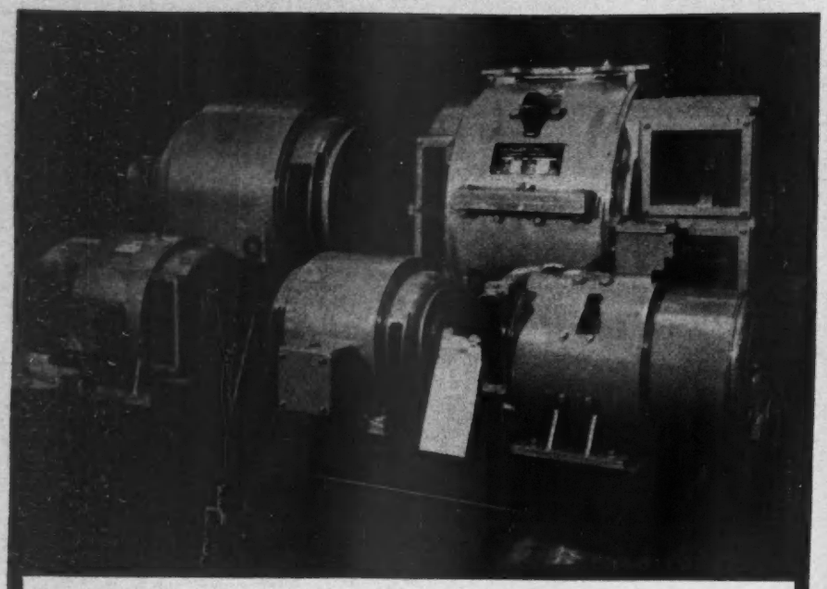

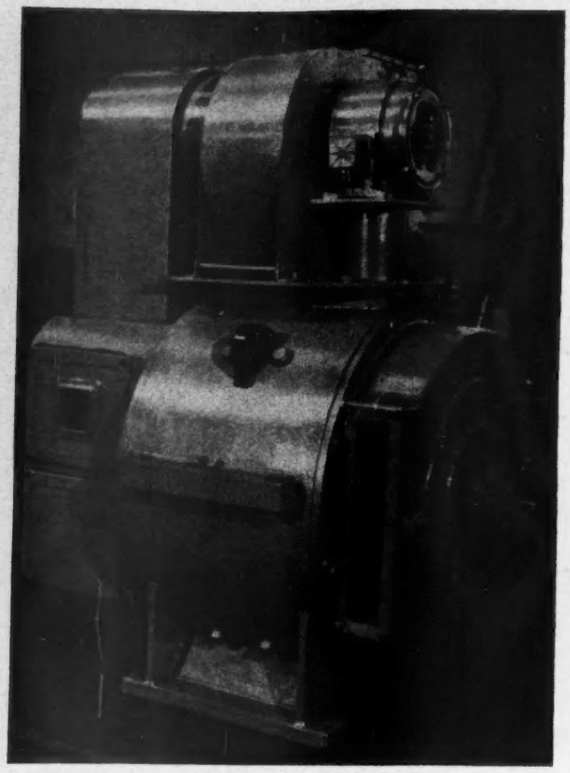

LEFT: Main motor generator set, output 0/220 volts, 200 kW max. In the foreground auxiliary set giving two D.C. voltages for drives to a calender. RIGHT: Work motor 240 h.p. 0/220 volts D.C., speed range 0/1500.

One of the control panels for above arranged for forward/reverse operation incorporating ganged motor-driven potentiometers and dynamic braking equipment for emergency stopping of main drive. Complete set designed for remote control.

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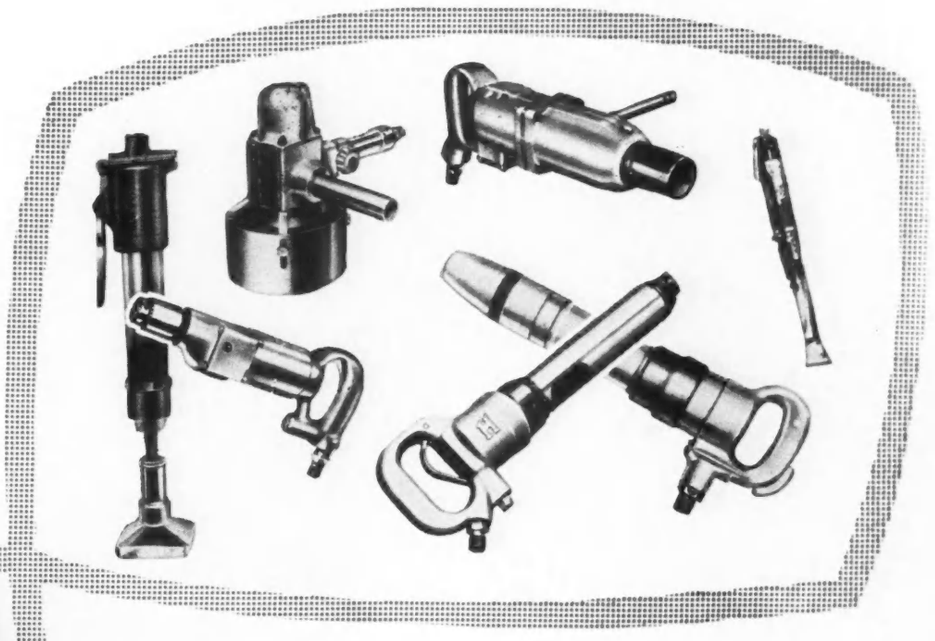

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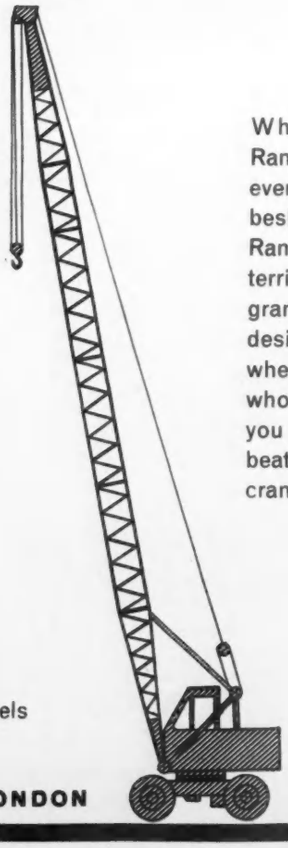

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511 Mobile Crane

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for the Scottish Gas Board's High Pressure Pipeline

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The pipes for the major portion of the pipeline —6⅝ in. to 12¾ in. outside diameter—are painted internally with red lead. They are protected externally against corrosion with Stewarts and Lloyds' woven glass reinforced sheathing. This has been specially devised to resist damage during transit, handling at site and soil stresses after installation.

This project is part of a grid scheme to distribute supplies of gas throughout Scotland.

ABOVE:
The Roman wall, built by the Emperor, Antoninus Pius, in A.D. 143, was breached near Bonnybridge to allow for the passage of the pipeline. (The wall was later restored by the contractors, William Press & Son Ltd.)

LEFT:
Welding a joint on the site.

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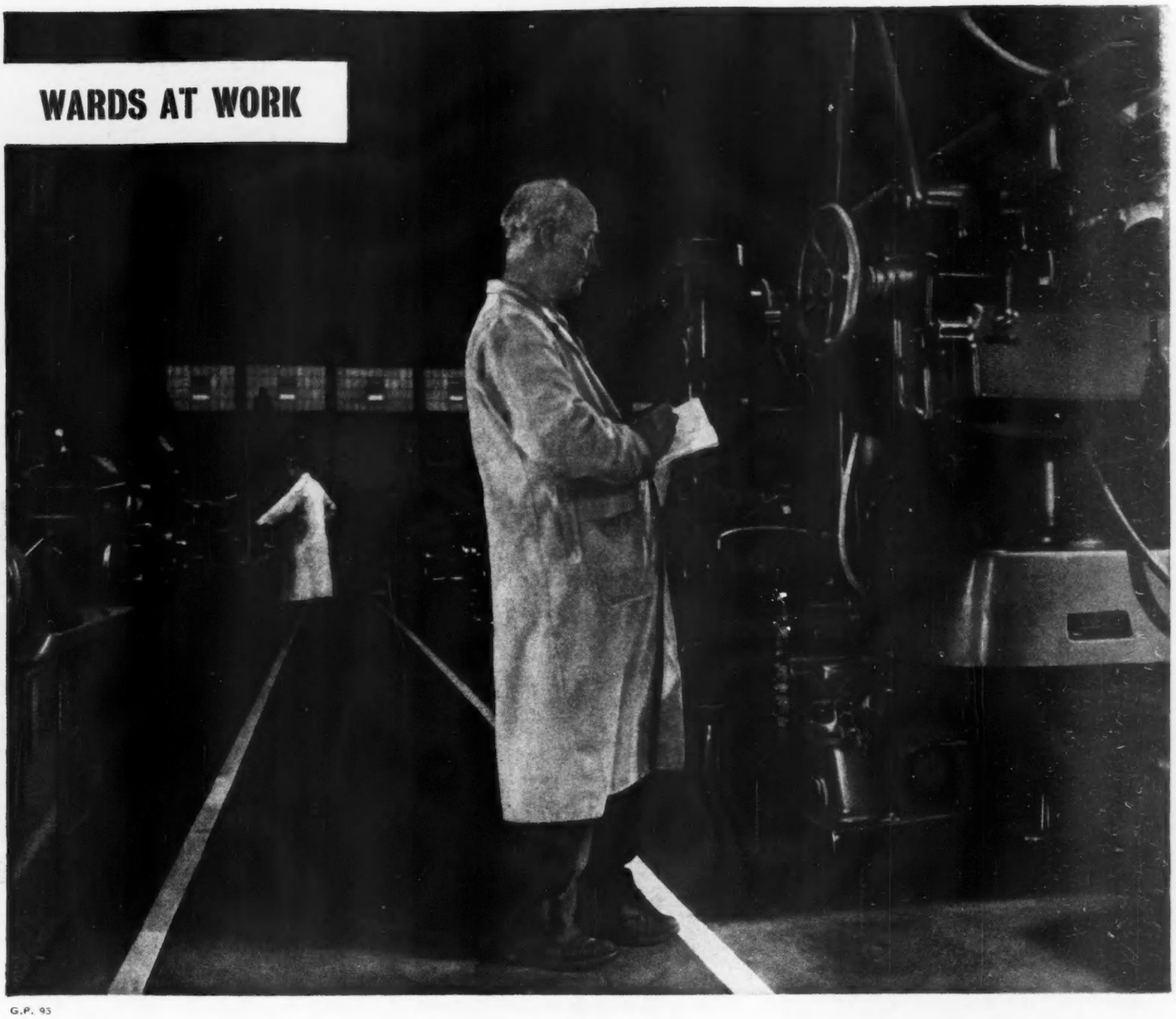
WARDS AT WORK



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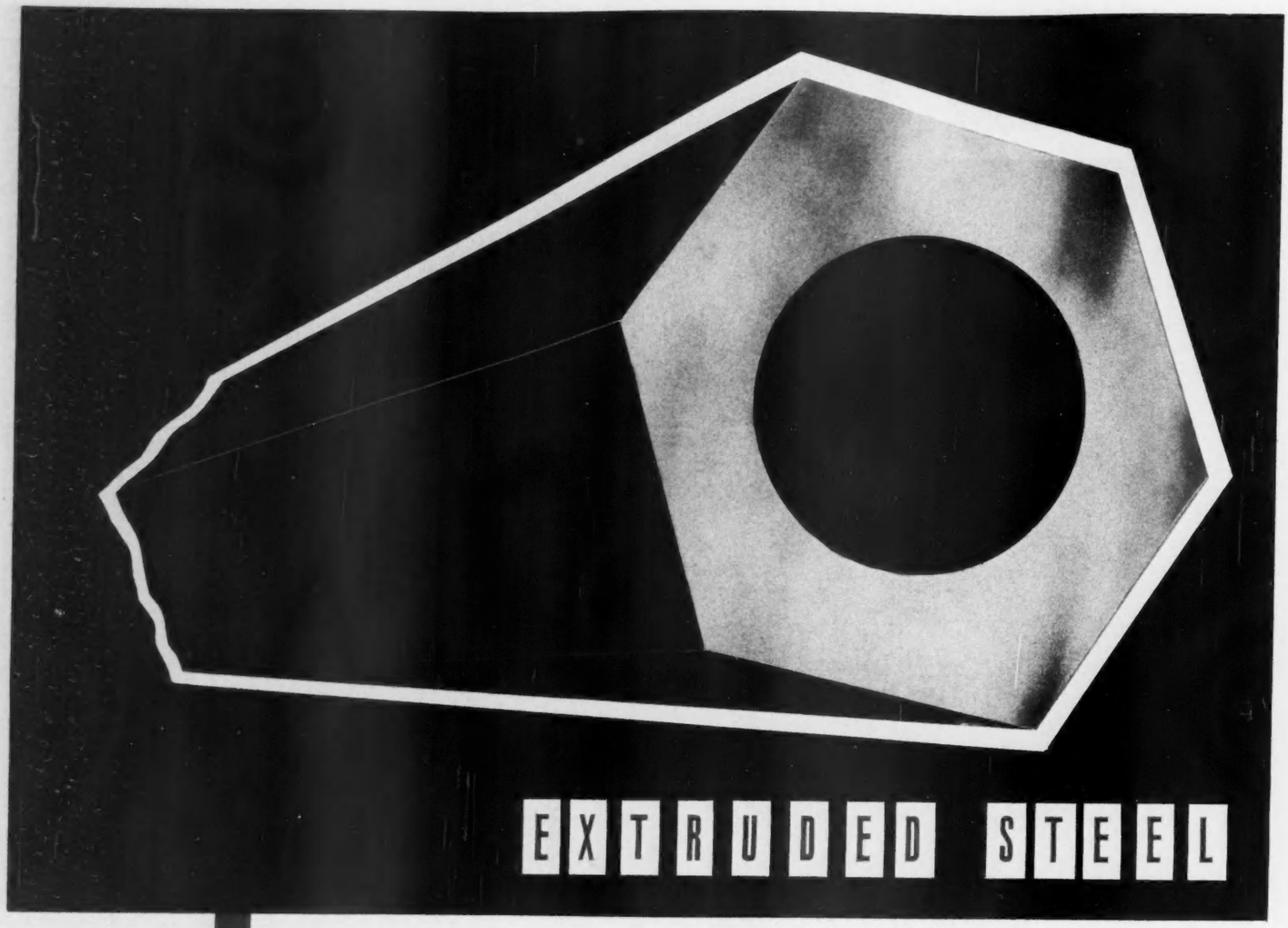

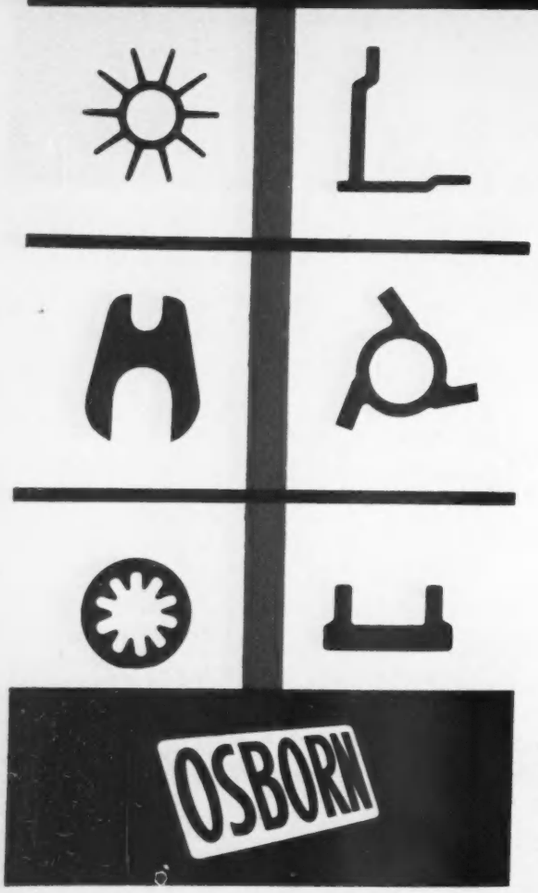

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Extruded steel sections are produced in most qualities of steel, including carbon and alloy steels, stainless steels and special alloys.

Hundreds of different shapes have already been extruded, ranging from simple angles to most complex shapes. Physical properties are identical with similar rolled sections and extrusions can be supplied in random lengths of 8 to 30 feet, with dimensional tolerances to suit requirements.

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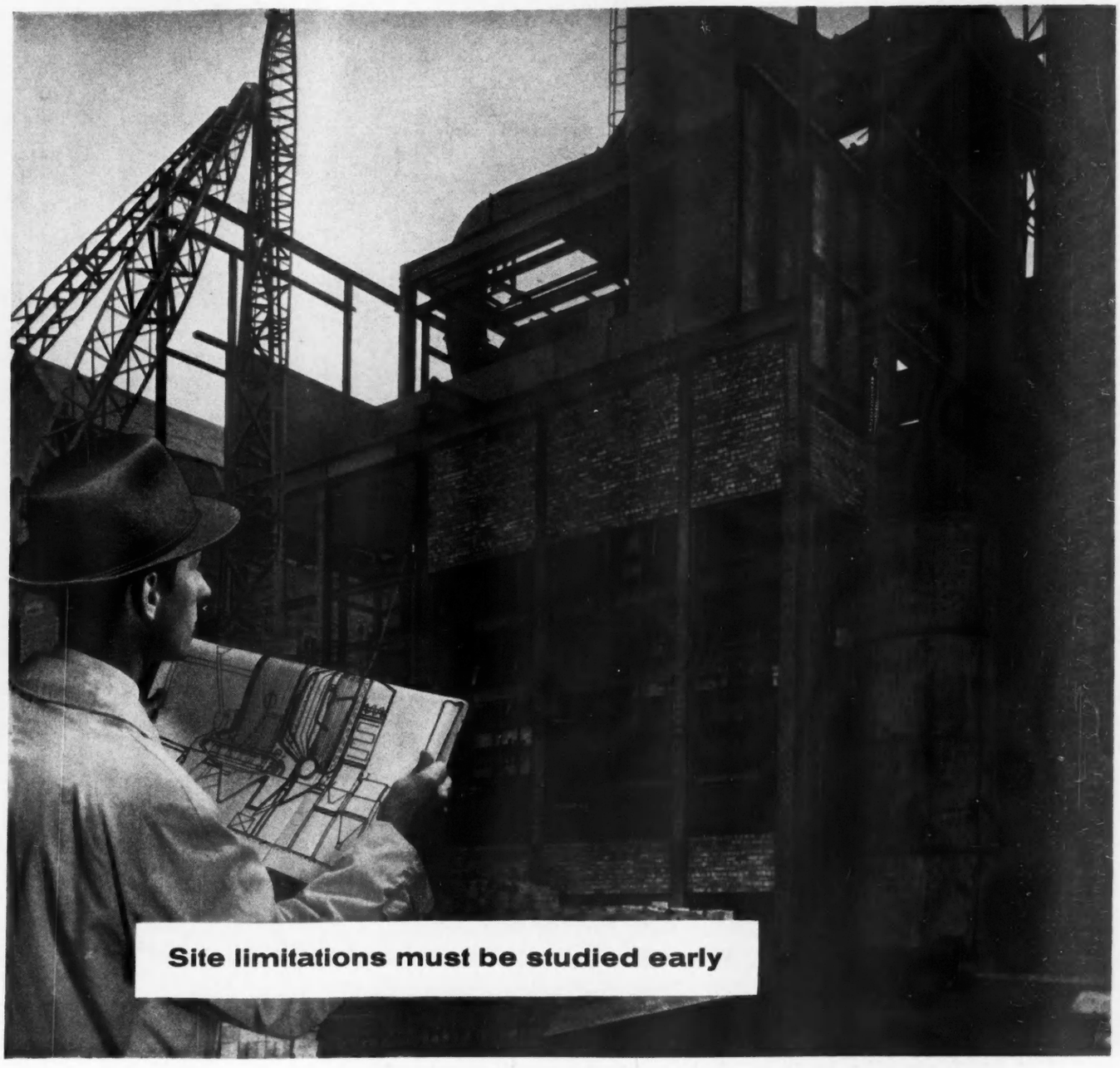

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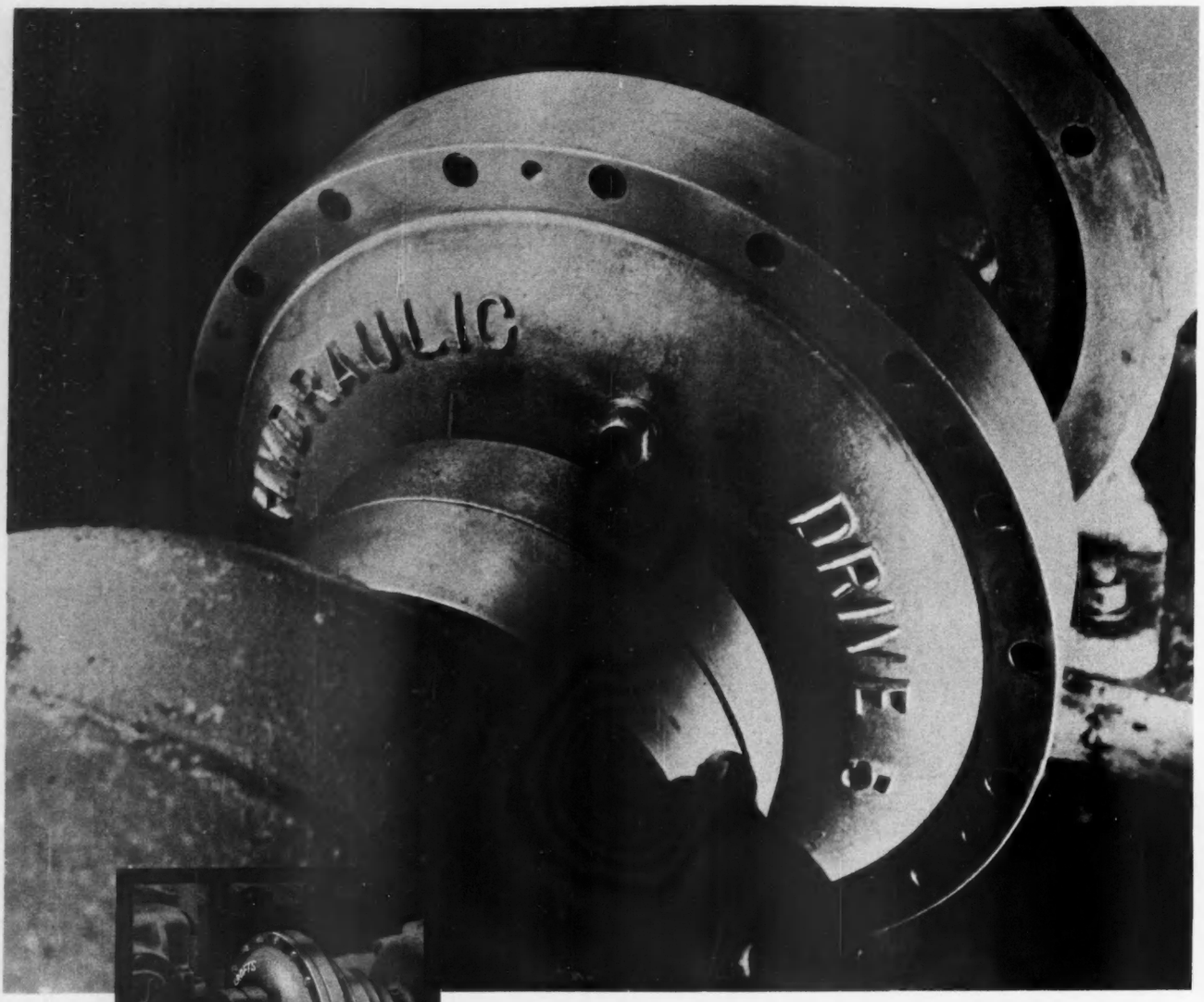

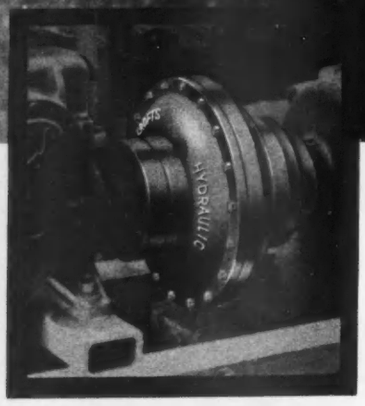

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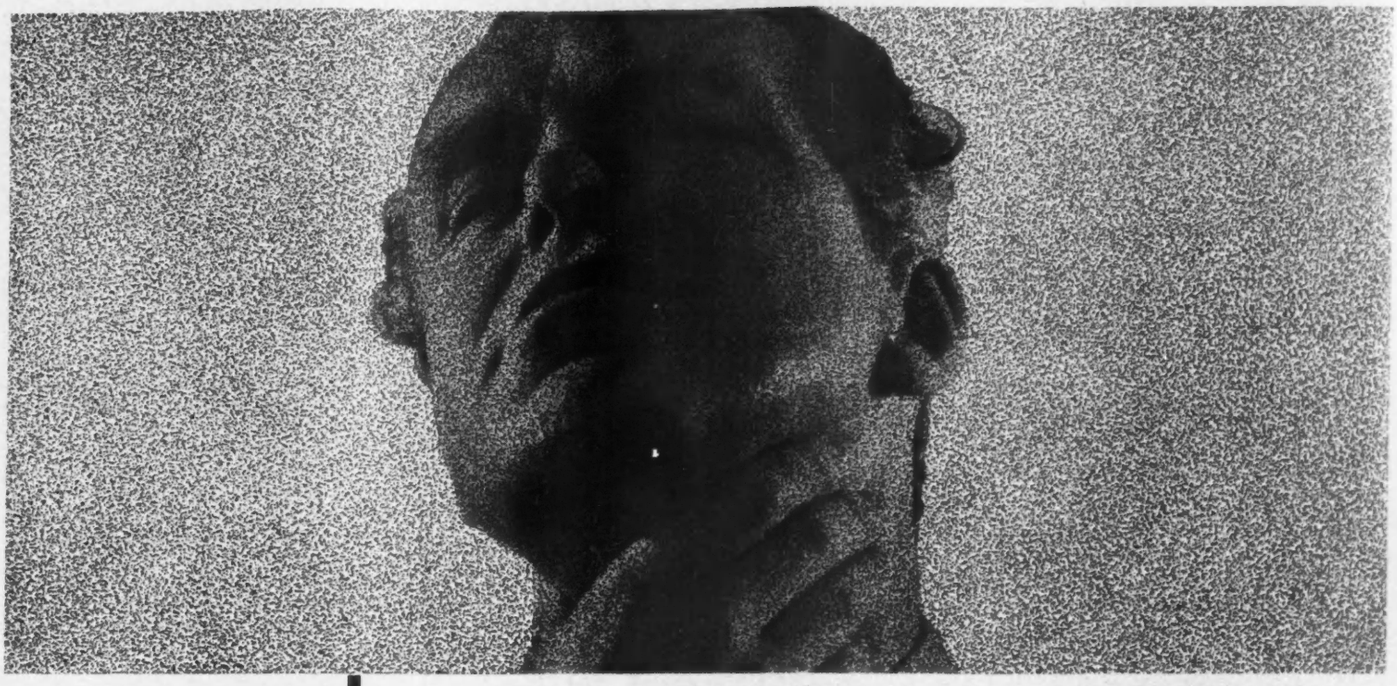

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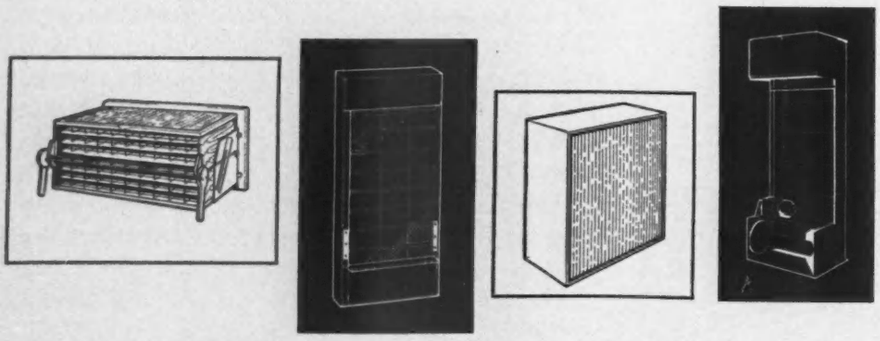

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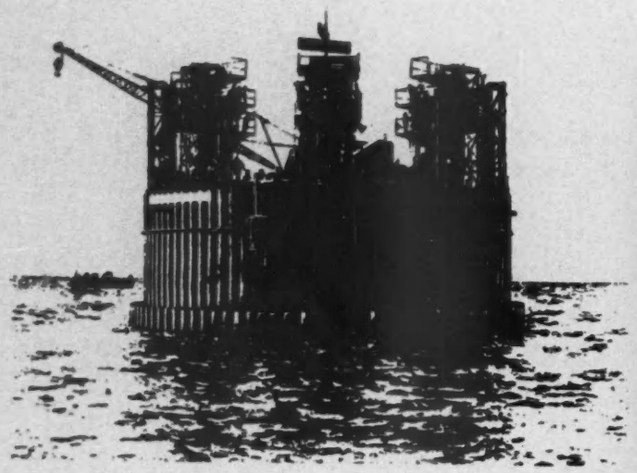

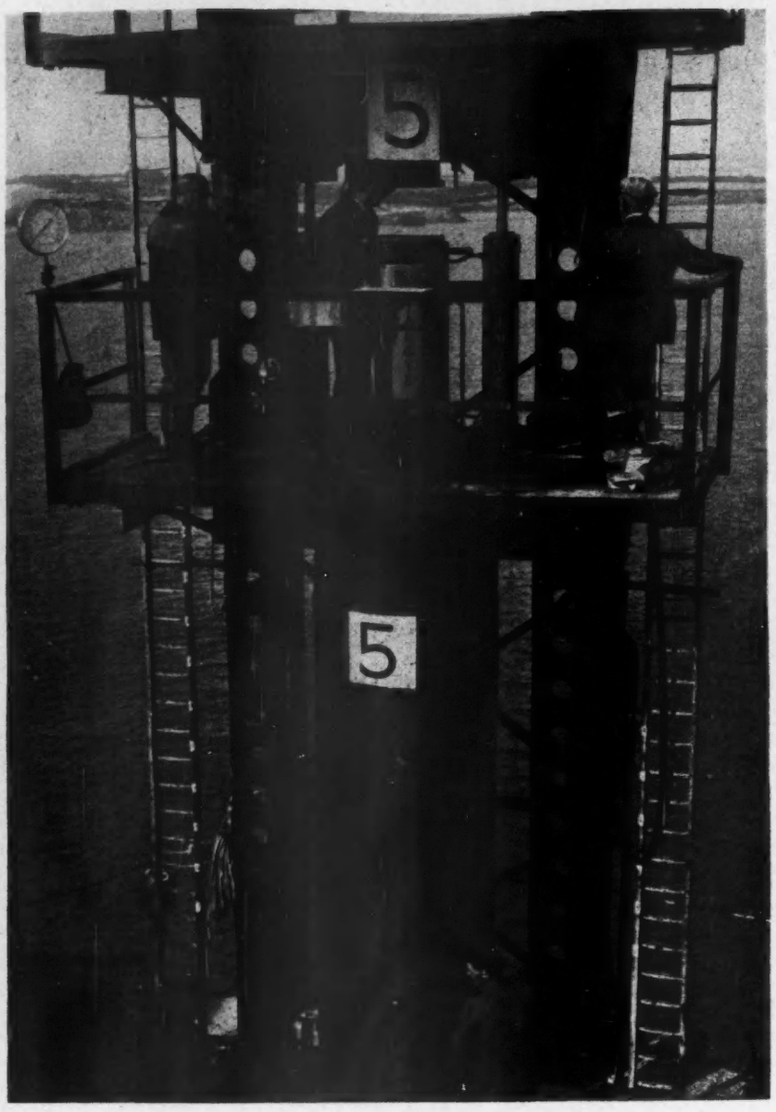

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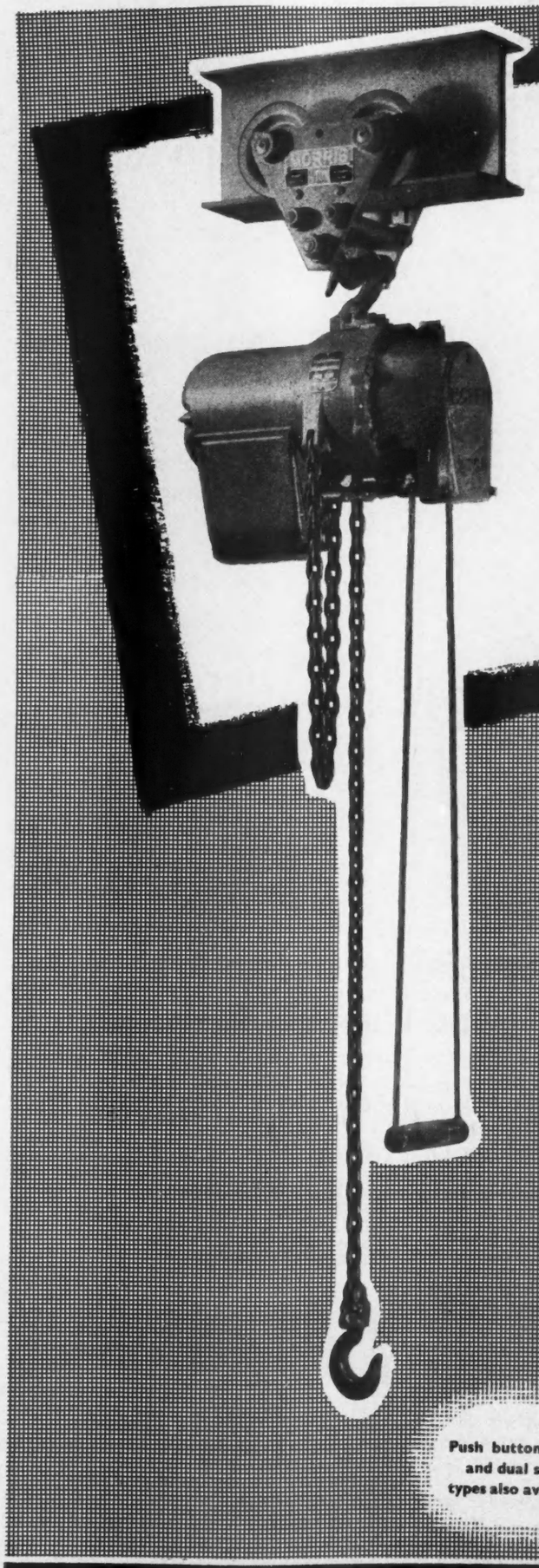

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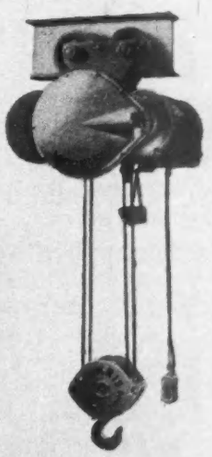

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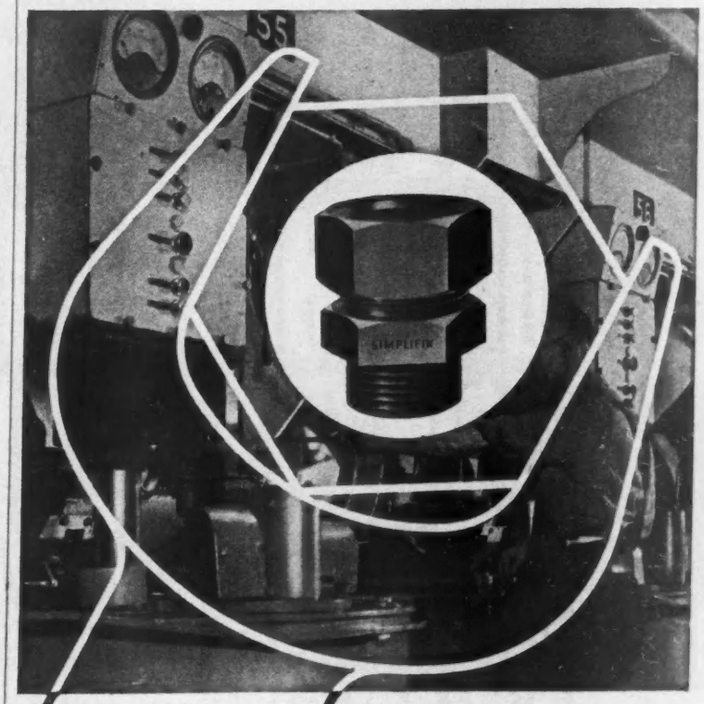

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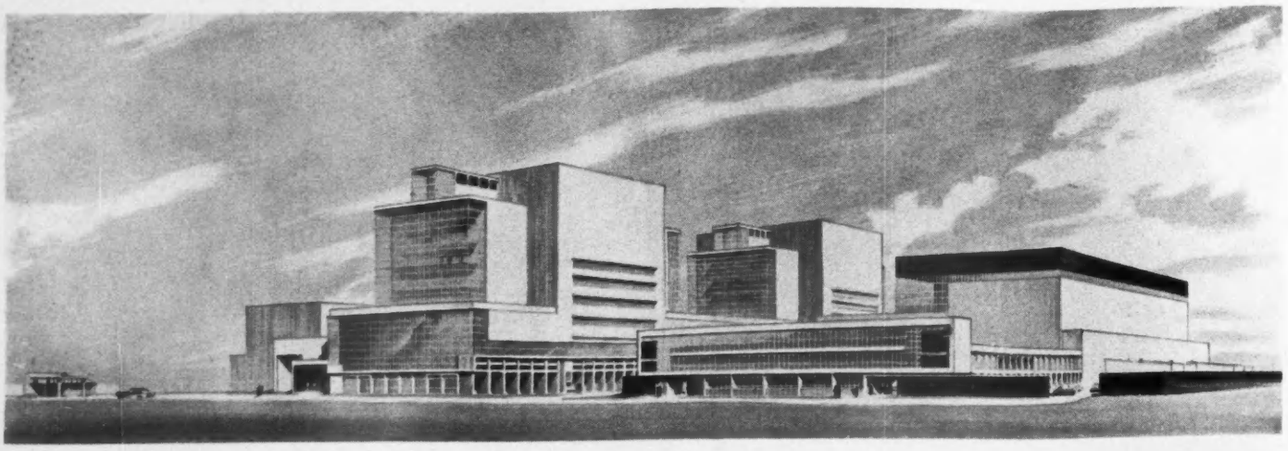

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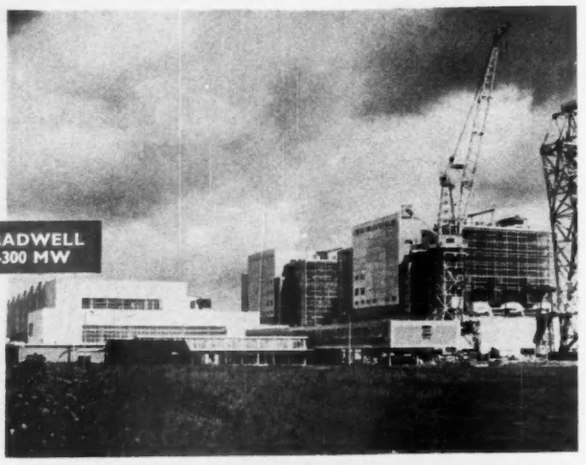
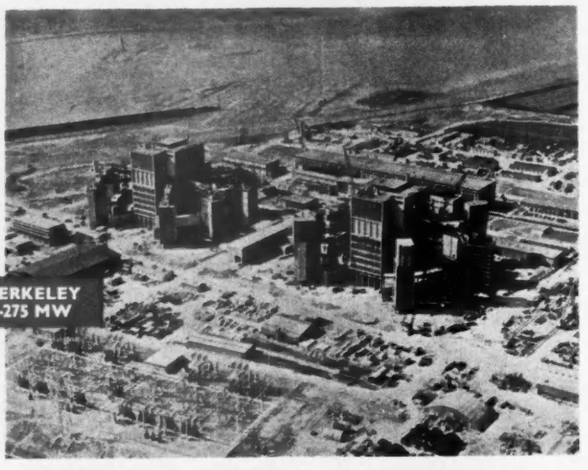
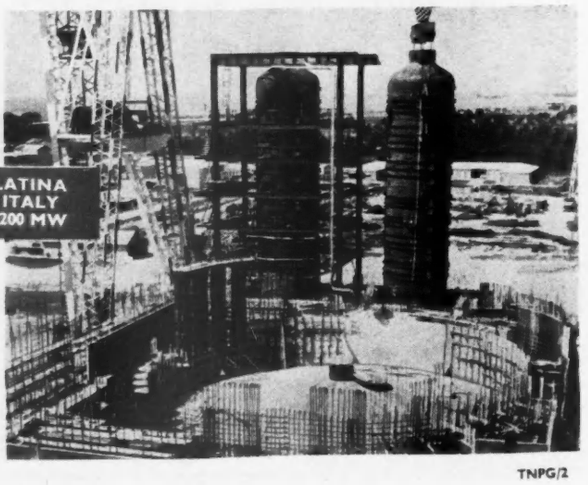


BRADWELL —300 MW



BERKELEY —275 MW



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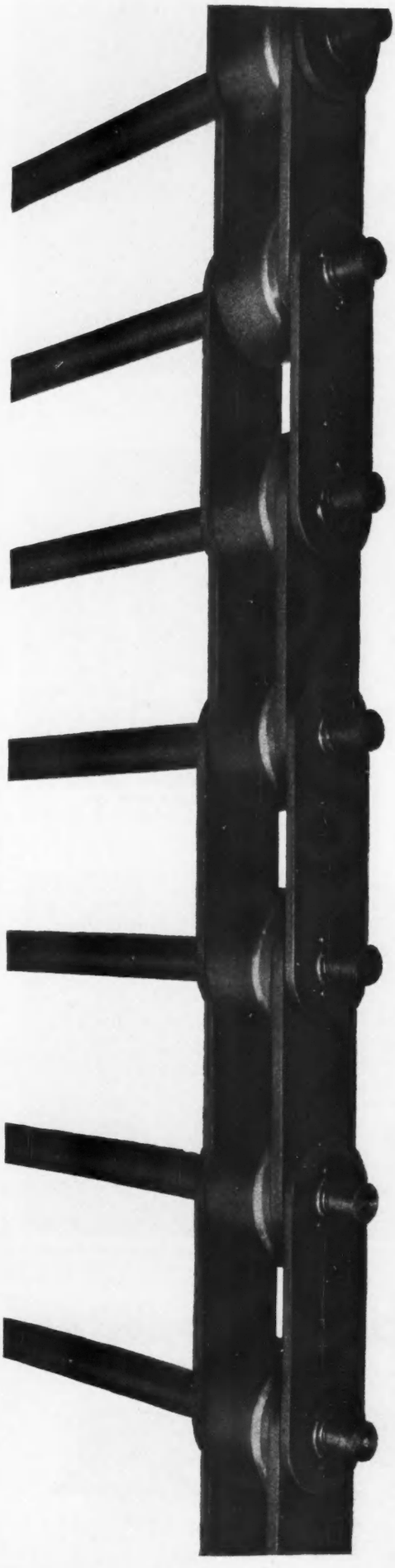

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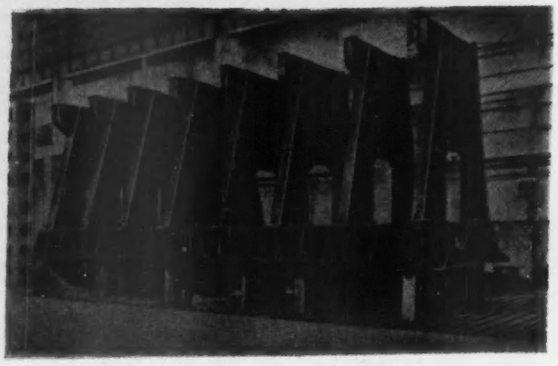

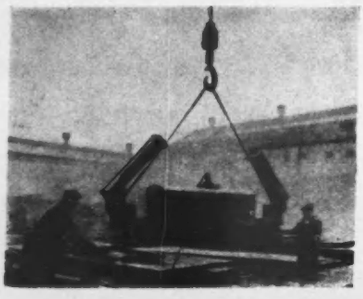

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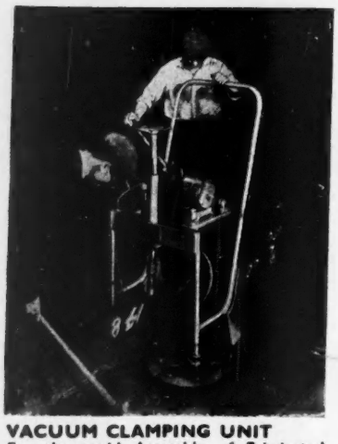

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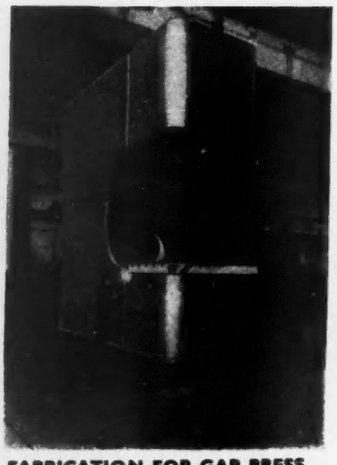

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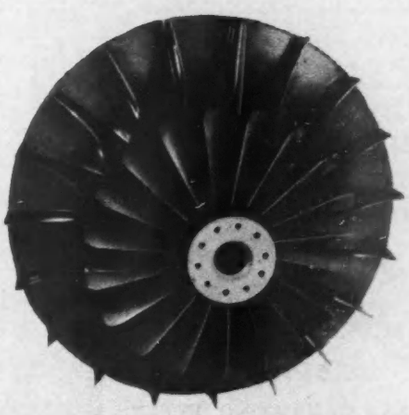

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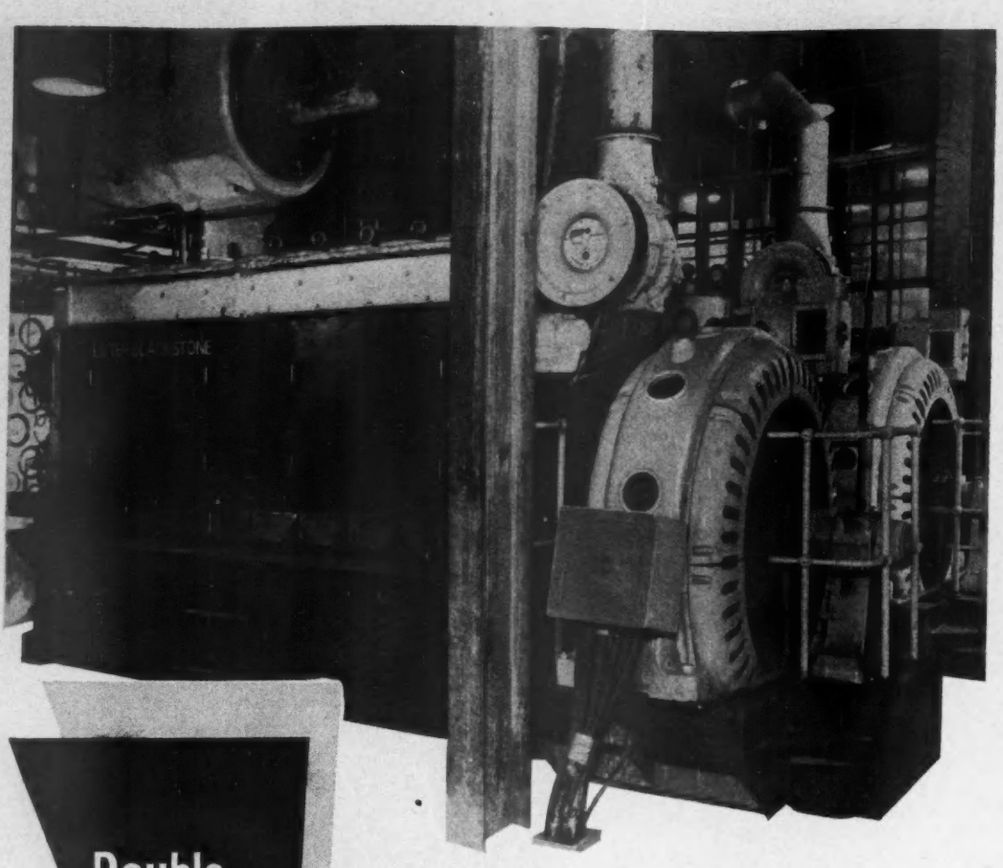

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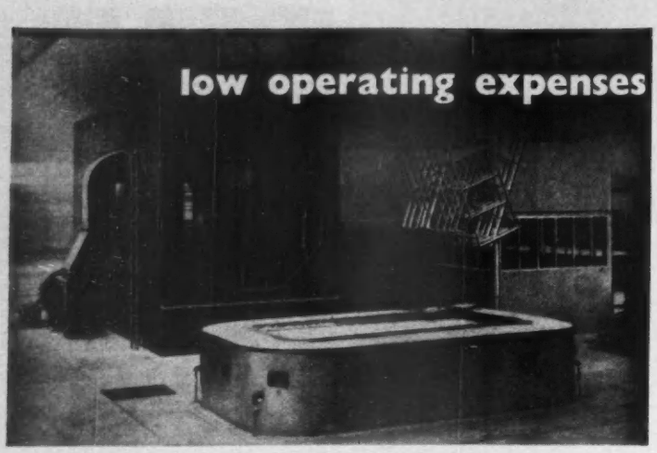

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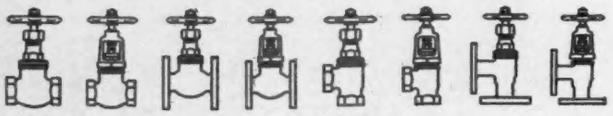
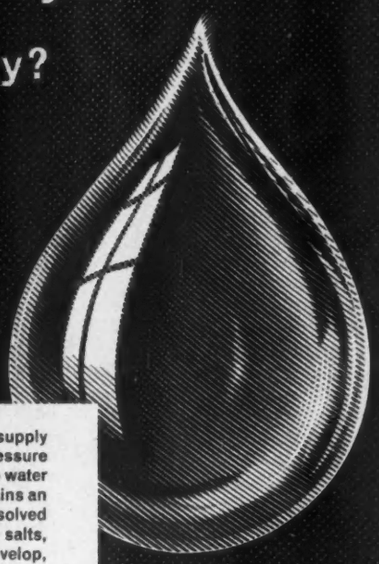


HV1

Did you know that this

drop of water

could sink you financially?



A boiler is designed to supply pure steam at a given pressure and temperature. But if the water used for the purpose contains an excessive amount of undissolved solids, harmful gases or salts, serious trouble may develop, and everything be up with the boiler. The results—delayed production, extra costs and loss of profits could be disastrous.

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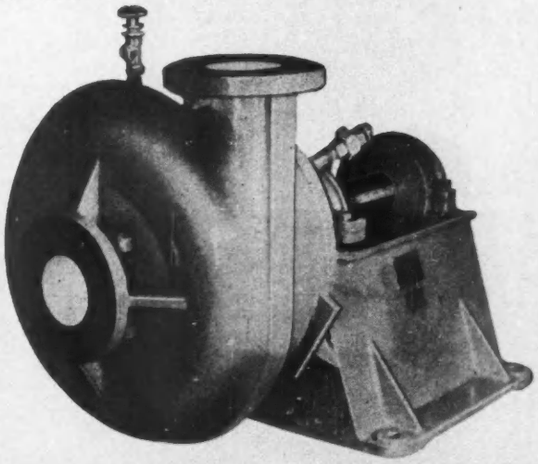

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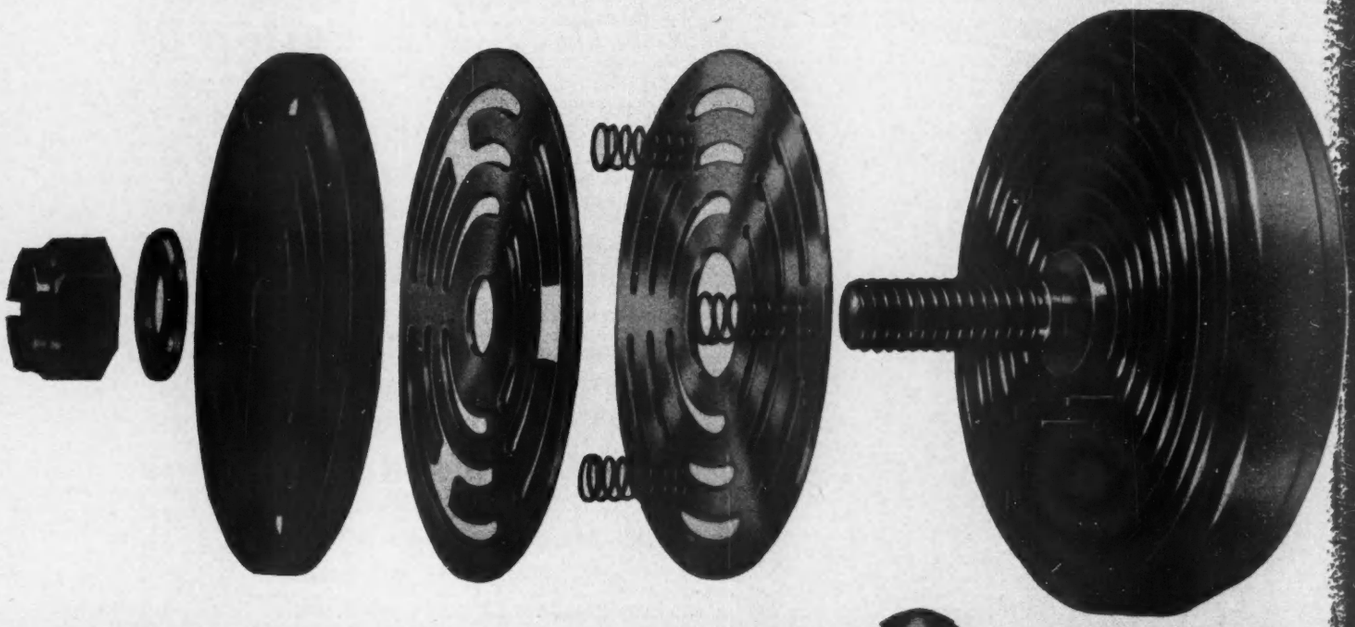

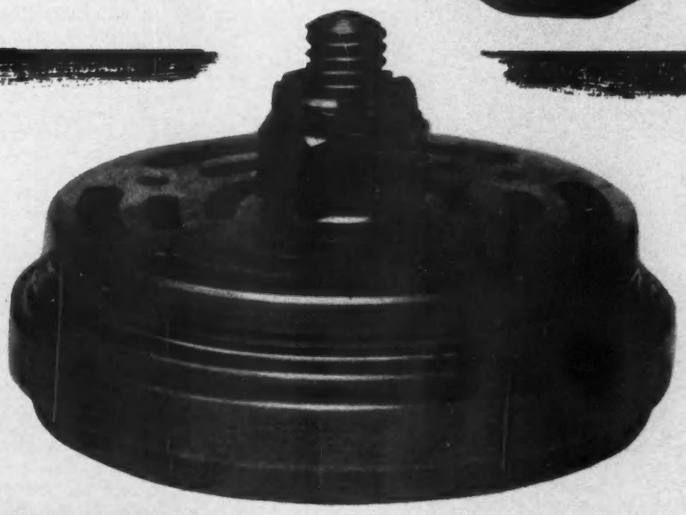

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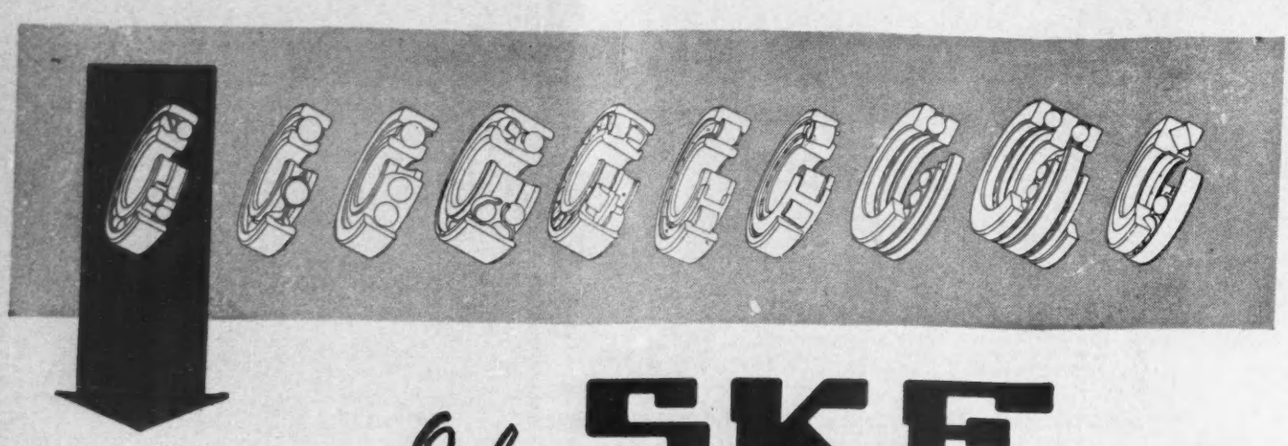
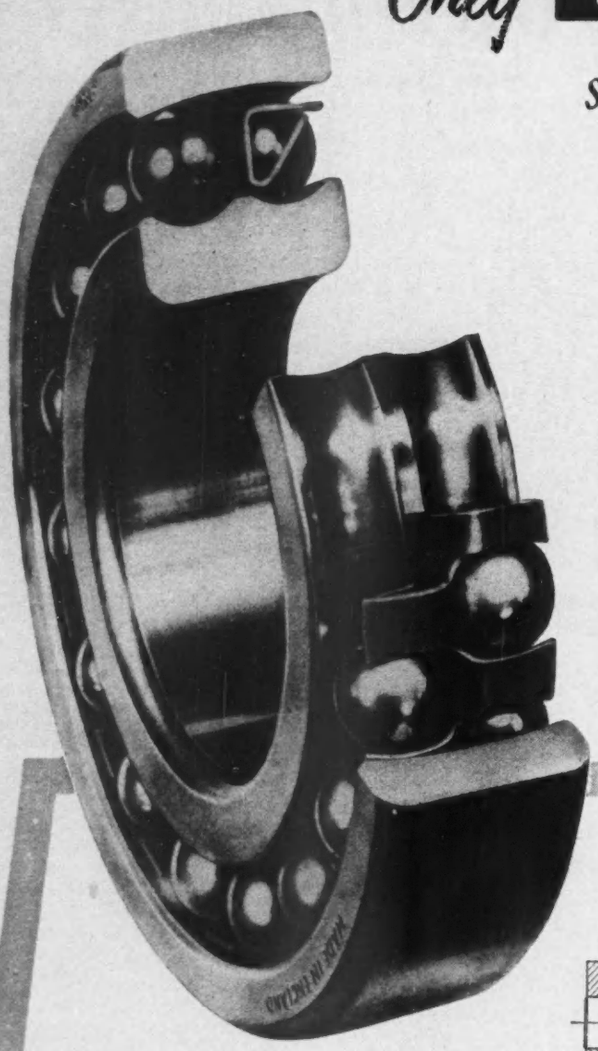


Only SKF can offer such a wide selection of British made bearings



The double-row self-aligning ball bearing, with its two rows of balls having a common sphered track in the outer ring, is completely self-aligning, and permits automatic adjustment to minor angular displacements of the shaft. Bearings of this type are particularly suited to applications where the speed is high and extra true running is required.

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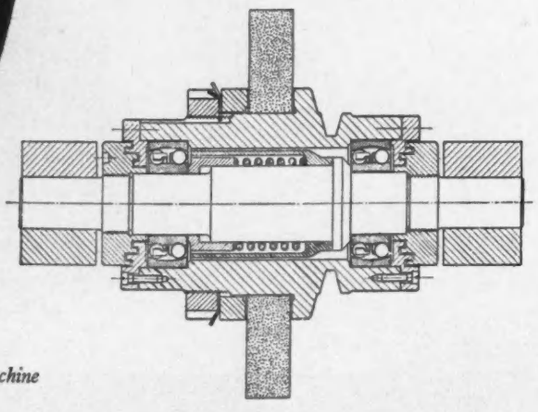

Bearing scheme for grinding wheel of leather shaving machine

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G177

ENGINEERING Impact

of Increased Unit Costs In Britain's Coalfields

EARLY next week the leaders of the National Union of Mineworkers are to submit to the National Coal Board a claim for an 18*s* a week increase for the industry's day-wage men and 30*s* a week for craftsmen.

If only part of the claim is met it will mean further additions to the costs of coal getting and consequent increases in the difficult competition with oil fuel. The union's chiefs have only a few days ago agreed to a reduction in the working week of 1¼ hours, a cut accepted as the best that could be agreed in the current slack state of coal mining.

While the NCB has said that the 320,000 day-wage men shall in the main be automatically protected from loss of earnings, the same has not been said for the greater number of the 260,000 pieceworkers. There is certainly an element of strong support for the feeling that the union's negotiators should have insisted on increases in piecework rates.

Shorter hours for the same money in the present position, with coal as hard to sell as it is, hardly makes a convincing proposition. What is now wanted in order that the pieceworkers should not suffer a loss in their earnings is an improved productivity—briefly, an output equal to that of the week which was longer by 75 minutes.

In addition to holding wage packets steady, improving productivity levels would benefit the industry in the better utilisation of machinery, in the easing of a number of problems of both personnel and plant at the pits and may well be particularly helpful if the threatened shortage of coal should develop in the further future.

Meanwhile the price of coal is inescapably a key factor in its selling power. The background of enormous oil reserves and governments disagreeing on price policies may mean that the predictions of noticeable oil price increases will come to nothing, or at least be long postponed. Either way a further increase in the price of coal could reverse the upward trend in sales recently reported by Mr. Alfred Robens.

Increasing the Brain Power In Machine Tools

The central point of agreement between Professor Seymour Melman, the Columbia University visitor to Western Europe whose criticisms of the machine tool industry touched so many sore spots, the sub-committee of the Machine Tool Advisory Council and the Machine Tools Trade Association is that there must be more, and more effective, research in the machine tool industry.

The sub-committee report rejects a great deal of the Melman thesis but it does call for doubled spending on research and much greater recruitment of qualified engineers. With a passing swipe at the shipbuilders, the report observes that with marine engineering excepted, no United Kingdom industry employs fewer graduate engineers and scientists.

Drawing on 1958 figures, and there may have been some change since then, the sub-committee points to an employment of only 25 graduate engineers among 90 machine tool firms employing 30,000 people.

There is a double reason why we have swiftly to begin to do very much better. By staying out of much of the rapidly growing market in high-precision and high-performance machine tools the British industry has allowed its share of a growing world trade to shrink.

The second reason is the straightforward one that British manufacturers well know the advantage their foreign competitors gain from superior machine tools—and go out and buy the same for themselves. But an advancing national machine tool industry should be able to give the benefit of its progress to its own country's industry first.

Up to a point those who come along next are starting the export race under a handicap. It is not just a matter of pushing up our machine tool export earnings but of giving all our industry better home built machine tools, as well as cutting down on the cost of imports.

The Machine Tool Trades Association spokesman has said that there is now a much more receptive spirit in the industry towards using the best brains that can be bought and to increased research spending. What the graduate engineer who is considering where to make his career will want to know is whether this conversion is permanent. He does not want to be hired so much as to join a team.

Practical Example from Two Top Companies

David Brown Industries and Electric and Musical Industries Electronics both stand among the leaders in their diverse fields of manufacture.

When the official reports on what should be done in the better development of the machine tool industry are actively being discussed, it is informative to hear from the two companies that their joint programme of applying electronic techniques to machine tools is to be expanded to use the resources of both concerns to the full.

The David Brown-EMI Electronics cooperation, involving very close team work indeed between machine tool engineers and control system engineers, preceded the recommendation of the Machine Tool Advisory Council subcommittee that electronic control of machine tools should be developed.

An early result of this collaboration was the electronically controlled gear hobbing machine exhibited at the Machine Tool Exhibition in June. It is known that other complete machines, and devices for inspection and control, are planned.

It is an interesting speculation as to which other famous electronics concerns will get together in the fruitful field of giving machine tools this immensely advantageous face-lift.

The electronics industry has developed faster perhaps than any other since the war, mainly by selling its products and services. It is a fascinating development, that of direct cooperation between electronics firms and the most imaginatively led of those in older established industries.

of Sharing Our Industries With the Developing Nations

Since the Second World War ended people in many countries have become accustomed to suggestions that they should surrender part of their sovereignty. To some degree membership of NATO and of a number of financial agreements is essentially a surrender of national freedom of decision. Equally, the Holy Loch base for United States Polaris-equipped submarines, with its attendant risks as a target, is accepted more on the basis of shared common objectives than on any serious belief in control over the missiles carried by the submarines.

Now a new form of international sharing is proposed—and if any one thing is certain about it, it is that more of the idea will certainly be heard in the future.

The annual report on international trade, compiled by the secretariat of the General Agreement on Tariffs and Trade (GATT), quotes from a talk given in Italy earlier in the year by its executive secretary, Mr. Eric Wyndham White. The executive secretary said: "It is difficult to escape the conclusion that one of the contributions which the older industrialised countries will have to make will be to surrender some sectors of light manufacturing to new industries in developing countries, finding their compensation in concentration on the more specialised and dynamic forms of industrial production on which their economic growth in any case depends."

This is dynamite. Quite apart from what the people employed in light manufacturing concerns, and their owners, may think of the suggestion, there is the enormous question of how it could be done.

So far there is no power in Britain, or in many other countries, to prevent a group of people starting up a business, always provided that it is legal and not downright undesirable. Light manufacturing in the industrialised states exists to cater for a market; the enterprising firms also tackle the export markets. It is easy to see how if a particular concern was exported to, say, West Africa, its teething troubles in settling down, and the added transport costs burdening its product, would allow another manufacturer to spring up in its place at home.

This, of course, is not the whole story. It is possible that a particular manufacturing concern, whose directors saw the advantage of cheaper labour in a developing state, could come to arrangements with its customers, transfer the business across the sea and carry on. There have been immigrant industries to Great Britain just as there have been immigrant families.

It is already possible to point to something of what Mr. White forecasts now taking place in 1960. International Standard Triumph have opened their assembly plant in Belgium this year. Belgium may not be one of this world's developing countries but the principle is the same. Jaguar Cars have recently come to an agreement for the assembly of some of their cars exported knocked down to Durban, South Africa. This is the exporting of assembly work, though it is worth noting that both moves were to countries where a substantial market exists.

International Trade, 1959 (GATT, Geneva, HMSO, 14*s*) dwells in details on the raising of the per head income of the peoples in the emerging nations of Africa and Asia. For the per head income to reach an average of £57 a year (it is not possible to give a useful present average but £57 is considerably more) there would have to be imports from abroad worth something like £20 million among the general inflow of private and public capital. Even though this is a general calculation, taking in the next decade as its period, this is an enormous sum.

So far only the United States has operated in the field of aid and trade with the developing countries on anything like this scale, though the United Kingdom keeps on pegging away, mainly in the Commonwealth, and there are signs of stirring in West Germany.

Greater Exports Before Easier Home Markets

While exports go on falling and the home market goes on increasing its demands, there can be no relaxation of the credit squeeze—this was the substance of Mr. Macmillan's speech at the recent annual lunch of the National Union of Manufacturers.

This was not good news for those in the car industry, whether their part be that of short time workers, redundant men and women seeking other jobs or management wondering how to discover the Ford secret of success.

On the very same day that Mr. Macmillan was offering no immediate hope of a change that might set the cars rolling out of the showrooms again a vital matter was being heard in the Law Courts. The Restrictive Practices Court was hearing the case for and against an agreement which the Registrar roundly described as resale price maintenance by the British Motor Trade Association. The Motor Vehicle Distribution Scheme Agreement was described by Mr. Guy Aldous, Q.C., for the BMTA, as vital not only to the trade but to the nation.

There is no doubt that there has been some rationalisation in a number of industries where the court has dismantled the trading agreements and also some heavy price cutting. Whether or not this would happen in the motor industry is difficult to judge. But no one can deny that if price reduction followed it would be directly helpful in the overseas sales battles. By putting a happier look into our success in that field the motor manufacturers hold at least one of the keys to opening the door to an easing of the credit restrictions on the home market.

Meanwhile the plight of the motor industry becomes steadily more serious as it continues. Not all of the men who are lost to the component makers, as the depression hits them too, will readily return when car fortunes revive. For future car industry prosperity to be retarded because of what present difficulties have done to security of employment would be one of those harsh ironies which it is for management to as far as possible avoid.

See Who's Using Extruded Steel Sections

Here are firms who have put Low Moor's steel extrusions to good use. You have certainly heard that steel could be extruded; now judge for yourself what the potentialities are.

EXTRUSION of high strength alloys is made possible by lubrication with glass, and the name of the process which is well known in this connection is Ugine-Séjournet. So far about 30 firms have taken out licences from the French firm. Henry Wiggin were the first in the United Kingdom—for Nimonic alloys (which are based on nickel, not iron); second came Chesterfield Tubes with an exclusive licence for extrusion of high chromium-steels with concentric surfaces. Low Moor Fine Steels—whose products are featured on this page—were the third in the United Kingdom with a licence for Solid and hollow shaped extrusions.

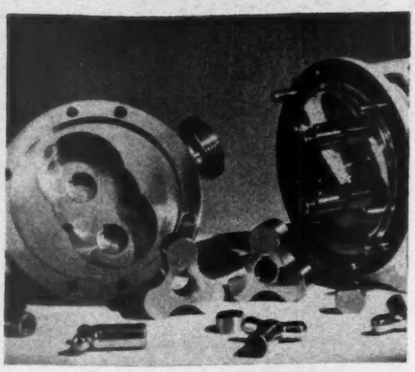
Examples shown here should speak for themselves in saying that the uses of steel extrusions are real, not could-be's. Take a good look at the attractive mechanical properties, but remember that there are some limitations on cross-section dimensions and lengths.

Low Moor Fine Steels Limited, Bradford.

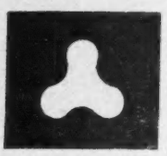
Mechanical Tests on Extruded Sections

Properties of extruded steel have often been quoted as being better than from other hot working methods. These tests were performed by Low Moor Fine Steels and show actual test results. Where a British Standard exists for the steel in the forms indicated, these properties are shown in bold type. Look at any or all of them and the claims for good properties are substantiated.

0·2 per cent proof stress, tons per sq. in	Ultimate Stress, tons per sq. in	Elongation, per cent	Izod, ft-lb	Hardness Brinell
En58A Extruded and cold drawn, Composition: 18Cr-8Ni				
40·8	52·0	38	106	—
En58 Refined 870° C, hardened 770° C, water quench Composition: 0·10/0·15C-0·3/0·06Mn-0·10/0·35Si-2·7/3·3Ni-0·3 max.Cr				
—	**45 min**	**18 min**	**40 min**	—
—	55·0	21·0	59	—
3110 As extruded Composition: 18Cr-8Ni-Cb				
13 min	**35 min**	**30 min**	**50 min**	—
14·05	38·40	56·0	116	—
15·10	41·36	53·0	111	—
14·00	40·00	51·0	109	—
Fortiwold RR249 Normalised 970° C, air cooled, tempered 700° C, water quench				
30 min	**38 min**	**18 min**	—	**179-255**
36·15	42·50	26·0	—	197
33·50	42·75	23·0	—	207
34·88	41·00	24·0	—	207
En58CM(DTD525) Hardened 960° C, oil quench, tempered 700° C Composition: 0·23C-0·25S-12Cr				
—	**45-55**	**15 min**	**20 min**	**192-269**
—	50·05	22·0	35	235
—	47·20	29·0	59	207
—	49·44	28·0	39	223
RR414 As extruded Composition: 18Cr-8Ni-Cb				
—	**35-55**	**30 min**	—	**140-220**
—	40·40	52·0	—	179
—	40·6	47·0	—	179
—	38·50	49·0	—	170
En56B Hardened 960° C, oil quench, tempered 750° C Composition: 0·15C-12Cr				
34 min	**45 min**	**20 min**	**25 min**	**201-255**
37·20	48·80	27·0	87	217
37·0	49·00	29·0	75	228
44·00	50·50	25·0	70	228
En56B As extruded Composition: 19Cr-8Ni-Ti				
12 min	**35 min**	**30 min**	**50 min**	—
22·30	36·50	53·0	108	—
24·8	39·20	49·0	106	—
22·20	39·40	50·0	110	—
BS512 Mild steel tube as extruded				
—	**20-28**	**25 min**	—	—
—	24·52	47·0	—	—
—	27·80	38·0	—	—
—	27·50	38·0	—	—

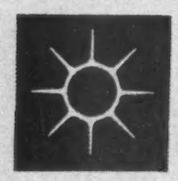


Howard Pneumatic
Pump Impellers



Use of this extruded steel section is enabling Howard Pneumatic Company to reduce machining costs on their rotary pump impellers. The alloy is an austenitic stainless steel corresponding to En58J. The company used to start with round bar; now the extruded stock is delivered in up to 10 ft lengths from which the impellers can be sawn directly and given only a finish machining operation. Accuracy on the extrusion is 0·030 in.

Courtaulds
Heat Exchangers



One of the most popular extruded sections is the finned tube for heat exchangers. Courtaulds were the designers and main contractors for a carbon disulphide recovery plant which has been erected in Greenfield, Flintshire. The material they employed for such tubing was a carbon steel corresponding to specification En32A, hardness between 130 and 140 Brinell. The design and material have proved successful and another plant has been ordered.

This particular type of finned or fluted tubing was chosen because the substantial thickness of the fins gave a high thermal efficiency with long life under erosive conditions and minimum resistance to the flow of carbon granules.

Stanton Ironworks
Feeder Trough

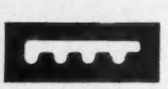
This seemingly simple section would cost a great deal to machine from square bar. It is used by the Stanton Ironworks Company as a feeder trough when casting their spun iron pipes. The new section is in medium carbon steel corresponding to En9 and is supplied to Stanton in lengths up to 20 ft.

Mather and Platt
Steriliser Seal

Steriliser equipment in the food canning industry needs good seals. Mather and Platt have recently started using a steel extrusion for making the ring which retains the lower part of the seal. The material is a mild steel corresponding to En3A.

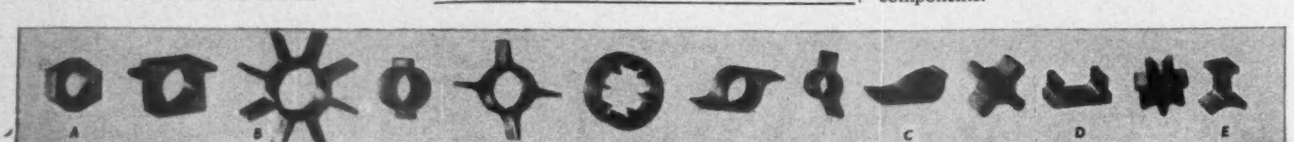
This seemingly simple section used to be made by welding from strip after being formed into the circles needed for the seals. Mather and Platt now save money by using the steel extrusion and have a section on their sterilisers which looks better and forms a better seal.

Rolls-Royce
Support Rings



This single extrusion is in RR414 alloy which is an austenitic heat-resisting grade similar to steels in the En58 range. Lengths are rolled by Rolls-Royce into circles and are flash-butt welded. After being stress relieved, four rings can be machined from the circle without removal from the lathe. These are destined for duty as support rings as part of the fabrication used on the Conway engine.

Rolls-Royce therefore benefit from use of extrusions by the reduced raw material cost of approximately 15 per cent. There is, of course, also some saving in machining time (about 12 per cent) against the previous method of utilising a ring-rolled forging also making four components.



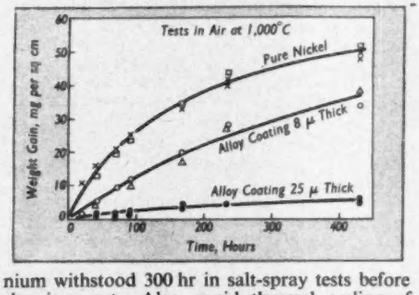
A—Stainless steel hexagon sold in tons per month saves drilling in nut and hollow-fitting manufacture. *B—Heat exchanger in low carbon mild steel.* *C—Pawls are cut from carbon steel extrusion.* *D—Support ring section for Rolls-Royce.* *E—This section for fire tube supports will withstand 1,100° C.*

High Temperature Protective Coatings

National Bureau of Standards, in a programme sponsored by the Wright Air Development Center, has developed a method for producing nickel-aluminium alloy coatings capable of protecting metals from oxidation at temperatures up to 1,000° C.

The most satisfactory procedure consisted of electrodepositing nickel from a Watts bath and then electroplating aluminium on this at a current density of 2 to 15 amps per sq. dm. The aluminium was deposited from a fused salt solution containing a mixture of potassium chloride, sodium chloride and cryolite at 700° C. At this temperature, aluminium diffuses into the nickel layer as it deposits, thus forming an alloy. (See also *J. Electrochem. Soc.*, 1960, vol. 107, p. 272.)

Steel specimens coated with the nickel-aluminium alloy were tested in salt-spray, in outdoor exposure, and in air at elevated temperature. In air at 550 and 1,000° C, the alloy coatings oxidised at one-tenth the rate of nickel coatings of comparable thickness. Steel panels coated with 0·002 in of nickel and 0·005 in of aluminium withstood 300 hr in salt-spray tests before showing rust. Also, rapid thermal cycling of these panels between room temperature and 550° C did not affect their corrosion resistance.



Corrosion studies conducted on atmospheric exposure racks correlated well with the salt-spray tests. The alloy coated panels did not show rust at the end of one year; in comparison, nickel-plated controls rusted after four months.

The coatings provide suitable protection for steel, nickel and molybdenum, and are probably applicable to other metals. Coatings 50μ (0·002 in) thick protected steel from oxidation at 550° C, but did not afford adequate protection at 1,000° C because the iron diffused through the coating. Thicker coatings would probably be satisfactory.

National Bureau of Standards, US Department o Commerce, Washington 25, DC, USA.

Colourful Steels Coming to Europe]

Allegheny Ludlum in America produce stainless and special steels. And they are soon going to in Europe as well, for at the end of October this firm announced plans for formation of a company with a plant to be built in Belgium involving capital investment of over $10 million.

This note has been headed "Colourful Steels . . ." because the American firm is always having ideas on how to make good use of their stainless products (they also have them on their electrical, tool, die and special steels as well). Thus the article in ENGINEERING, 22 April '60, pp. 540-41, on materials for curtain walls and cladding, reported that this company had started offering coloured stainless steel, first of all in shades of brown and black, and would soon do so in blue, green, red and grey. This is achieved by application of a chromate-based coating similar to that used on the inner lining of metal containers. It is applied like paint and is cured at temperatures of about 350° F.

Now Allegheny have inspired another product by cooperating with another American firm, the Mirawal Division of Birdsboro Corporation. Once again their eyes are on architectural panelling as the main outlet; stainless steel sheets of only 0·016 in or 0·018 in thickness have been bonded to various structural insulation or laminate material backings. The secret, says the firm, is in the bonding procedure, but Mirawal will not reveal what adhesive system is being used except that it is a "plastic-type." Undoubtedly, the test of this is actual weathering; but how does the following appeal as a "climate"?

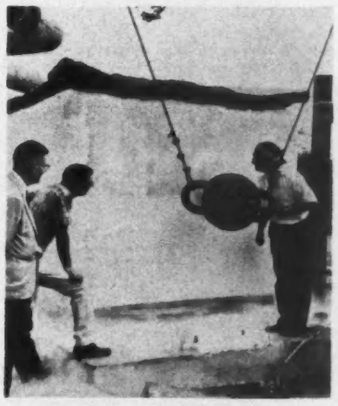
Mirawal panels have been subjected to live steam for more than three hours, immersed in water at 120° F for an hour, stored below freezing point at 10° F for nearly a day, and then heated to 210° F, sprayed again with live steam, and finally heated in dry air for 18 hours. After 12 cycles through this exhausting "climate" the skin was still bonded to the backing.

Allegheny Ludlum's entry into Europe has come about by joining up with the Belgian firms, Evence Coppee & Cie, of Brussels, and Societe Anonyme Metallurgique d'Esperance-Longdoz, of Liege. It is said that the American company will have equal ownership with the Belgians, and that production in the new cold-rolling and finishing facilities is expected to begin in 1962.

Allegheny Ludlum Steel Corporation, Pittsburgh 22, Pa., USA.

Nickel-Steels Strong at −200° C

It is still not clear whether there will emerge one material for use in cryogenics—for holding such gases as liquid nitrogen. Two serious contestants for this title are aluminium alloys containing magnesium and steels containing nickel. Thus in May this year, Northern Aluminium Company (now Alcan Industries) held a symposium whose virtual aim was to foster in people's minds the idea that the 4Mg-Mn-Ti-aluminium alloy B54SM is ideal for construction of tanks in any scaled-up version of the Methane Pioneer.



Now the International Nickel Company have fought back with a practical demonstration of the suitability of a 9Ni-steel. This is what they say about their tests. It is known that many steels although tough and strong at room temperatures become excessively brittle when cooled to sub-zero temperatures. It is also known that the presence of nickel greatly improves the toughness of steels down to temperatures as low as −200° C.

The newly developed 9Ni-steel has passed all the laboratory tests but as a practical demonstration of its suitability, three companies joined in organising a full-scale experiment which involved:

(1) Subjecting a welded rectangular tank, similar in design to those that would be used to transport methane in seagoing tankers, to repeated blows, up to and slightly exceeding 80,000 ft-lb from a 2 ton steel ball. In this test, which is illustrated, liquid nitrogen was pumped into the tank to cool it to −196° C.

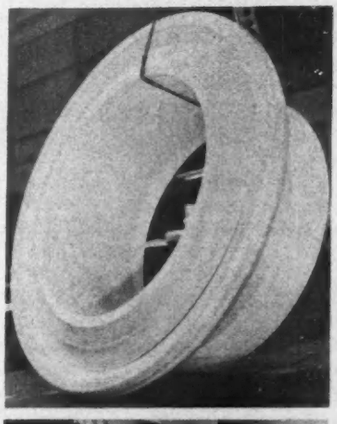
(2) Subjecting a 4 ft by 13 ft cylindrical tank, similar in design to one which would be used for land-based storage or transportation of liquid gases, to a pressure several times greater than its designed strength and then pressurising to failure for the fracture to be examined.

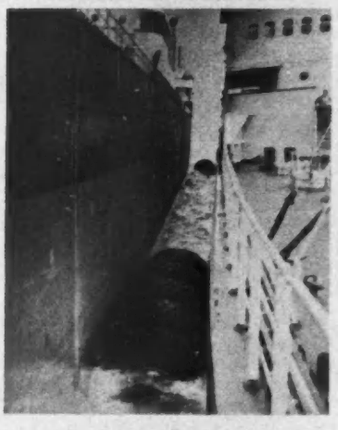
Cooperating companies were Inco, Chicago Bridge and Iron Company and United States Steel Corporation. It is reported that the tests described were carried out successfully in Pennsylvania in October last in front of three hundred people.

Mond Nickel Company Limited, Millbank, London, SW1.

Ships' Fenders

The need for improved fenders does not need stressing. So, despite the relative mechanical complexity of the design shown below, this improved ships' fender will probably be welcomed, particularly by operators of off-shore loading tankers. Marine Craft Constructors' new design involves the use of five giant tubeless





tyres, 10 ft in diameter, each revolving on its own bearings, and mounted on a steel cylinder with rotating swivel and eyes at each end.

Rims for these wheels were originally designed for sand casting, but to obtain a better mechanical structure with no porosity, they were finally hand forged in a 4Mg-aluminium alloy, Hiduminium 35. The 810 lb cast billets were hand forged on High Duty Alloys' 12,000 ton press. In the final design, two are required for each wheel. Marshall and Company carried out the final machining, and Schraders made valves in the same alloy to avoid corrosion. Giant tyres were supplied by Firestone.

Since the initial tests there have been twelve more tests in all weathers with vessels up to 40,000 tons. The last of these was carried out in a Force 7 gale, which resulted in the breaking of a 4½ in diameter steel mooring wire, but even so, the ships rode alongside each other without so much as a tremor.

High Duty Alloys Limited, Slough.

Plain Words

By Capricorn

DO WE move machines around from job to job as effectively as we move men? A man can usually be relied upon to look after his own interests, as he will try and make a move if he feels that his talents could be employed better elsewhere, but a poor mute machine just suffers in silence when he is not being fully utilised.

The appointments advertisements give ample evidence of the enormous traffic in executives which has grown up in the past few years. You can see how men are continually being attracted and moved to new positions where their special knowledge and experience can be applied to fresh problems.

I think there is similar scope with plant and equipment. Like men, many of them today are specialised. Their application or capacity is limited, but I suspect that often they are not being used in an optimum manner. They tend to remain with the same firm all their lives, and the production programme must often be adapted uneconomically to suit them. It is a painful and difficult business to give a man the sack (the phrase itself has a period flavour about it), but a machine is easily bought or sold. Yet I would take a bet that it is much rarer that we think of giving a machine the sack. We hold on to it, find work for it, keep it tooled up just for one job, or invent some other way of justifying its existence.

If only we would listen to the moans of machines, as we have to listen to the moans of men, we would begin to treat them sensibly and profitably. If anyone thinks this is just fantasy, let him take a car out that has been left idle for months, or take careful note of all the work that has to be done on a machine tool which has been out of action for some time. I once witnessed an attempt to restart a steelworks which had been out of commission for nearly ten years. Many man-hours were put into it, but in the end the attempt failed. Such a major example is rare, but the little examples are common and no one troubles to measure the cost of them.

In the Neasden maintenance depot of London Transport there are now several venerable steam locomotives—" pannier " tanks, as they are called—which served on the Western Region of British Railways, but because of the spread of diesel and electric traction, they have been sold to London Transport, which is almost entirely electric traction, to move trains about for servicing purposes. Those engines must be proud to find this new lease of life.

Is there scope for a new form of consultancy service? How about Machine Selection Limited? Or, as this would conflict in its initials with the pioneers of management selection services, Plant and Equipment Selection Limited? I think it would look rather good—" P.E.S. have been retained to advise on the selection of a machine. . . ."

Letters to the Editor

Progress in Air Conditioning

SIR, The comments published by ENGINEERING as a result of their survey on the use of air conditioning in British industry have pointed up a number of interesting aspects (" Plans and Demands in Air Conditioning," 4 Nov. '60, p. 610).

There is no doubt that industry in Britain is very much awake to the benefits of air conditioning. The large amount of money being allocated for the provision of air-conditioning plant is testimony to the acceptance of this aid to production in the works, the laboratory and in various office spaces. This acceptance of air conditioning on the part of industry follows very closely the pattern in other countries. Specific parts of industry are not taking up the idea of air conditioning, but rather progressive management in all types of industry, as is brought out in ENGINEERING's findings.

In regard to the " cautious attitude in parts of industry " it would seem that this indicates a possible deficiency in the air-conditioning industry itself, by not making available to the potential buyer a sufficiently good explanation of the benefits to be derived. Also, there seems to be considerable misuse and misinterpretation of the true definition of air conditioning as laid down and accepted by various world-recognised engineering societies.

The introduction of packaged-type air-conditioning units has made air conditioning available in many cases at considerably lower costs than would be the case with custom designed and built plant. If the trend of other countries is followed in the United Kingdom, the future development of air conditioning will be in the direction of the self-contained unit. Such units have been developed over the past 25 years by various companies, which spend millions of pounds annually in the constant search and research for improvements to their products.

Spiral conduit ducting is not unique to the Carrier Engineering Company Limited, as is suggested in Mr. J. A. E. Heard's letter (18 Nov. '60, p. 672). The Winsor Engineering Company Limited, Glasgow, a company associated with Carlyle Air Conditioning & Refrigeration Limited, have in operation a machine to produce the same kind of ducting. There is in addition, I believe, one other such machine in use in this country. A Carlyle self-contained air-conditioning unit as used for the control of humidity and temperature in a testing laboratory is shown in the accompanying illustration.

Among the points on air conditioning raised in the Companies note (11 Nov. '60, p. 649), it was suggested that " the necessity of providing conditioned air, other than warmed and filtered air, is not a matter of importance in view of the temperate climate ruling in this country." It should be pointed out that outside conditions of climate very frequently bear little relation to the conditions that exist inside factories and offices. Trends towards automation in processing have brought problems in heat gains quite outside past experience. When added to normal gains, such as lighting and solar radiation, the resulting internal humidity and temperature conditions are completely beyond the normal comfort zone.

Personal comfort is not a luxury. Statistics show that the use of air conditioning in industry can frequently raise productivity to a very noticeable economic degree. In addition, it improves labour relations.

Air filtration and the control of humidity reduce janitorial and decoration costs. But a still very important feature in large cities today is the reduction of the noise level. In offices it is no longer necessary to open windows to improve ventilation, only to be drowned out by the noise of traffic, jet planes and other nuisances. Air conditioning has made many things possible in the overall operation of a company's affairs.

Great Britain may have a temperate climate, but if that is the yardstick for the use of air conditioning, how can we explain the widespread use of air conditioning in the Scandinavian countries?

In this modern age, with improved designs and lowered costs, air conditioning is available to a widespread market and there is hardly an industry that one can name where air conditioning in its true sense cannot be used advantageously.

Very truly yours

RALPH S. REYNOLDS,
Managing Director.

Carlyle Air Conditioning & Refrigeration Limited,
London, SW1.
21 November, 1960.

A self-contained air-conditioning unit as used for the close control of humidity and temperature in a testing laboratory.

Mechanical Stresses in Transmission Lines

SIR, I have recently had the opportunity to read a short account in a German journal (*Energie*, Munich, Sept., 1960) about an overhead crossing of a river by an electrical transmission line. In the same article there is mention of plans to build more such long crossings in Britain.

I am interested in this subject because I have developed a method for the measuring of mechanical stresses in overhead electrical transmission lines. The advantages of this method are: the measuring is not hampered by bad visibility and it is independent of the coefficient of elasticity. The latter is important because the coefficient is dependent on the manufacturing and on the life of the cable.

The method of measuring is based on the phenomenon that, by beating a cable, transverse waves can be induced, the velocity of which is a function of the mechanical stresses in the cable. This velocity can be measured by a time-measuring instrument which is started at the moment of beating the cable and stopped at the moment of the arrival back of the same transverse wave, reflected by the next insulator.

In the case of long crossings, it is not the arrival of the reflected transverse wave that is measured, but only the arrival of the transverse wave at the other end of the crossing. The time of arrival at the other end can then be transmitted to the measuring instrument by an auxiliary equipment (wires or a shortwave transmitter).

I published details of the method mentioned above in the German journal *Energietechnik* (No. 10, Oct. 1960, p. 430) under the title "Messen der mechanischen Spannung in elektrischen Freileitungen."

Yours sincerely,
ISTVÁN ERDÉLYI.

Budapest, Hungary.
16 November, 1960.

Salvage Reclamation

SIR, In one of your Impact notes (ENGNG., 21 Oct. '60, p. 533) there is a suggestion that a Royal Comission on waste recovery should be set up.

I have read this note with great care and I thought you might be interested to know that quite a considerable amount of work has been done in connection with salvage, and that machinery exists today for dealing with waste recovery.

This Council consists of leading industrialists whose services are given voluntarily, and operates under the auspices of the Board of Trade. They aim to

(1) Reduce imports of materials by encouraging the disposal of redundant stocks.

(2) To find new outlets for waste materials.

(3) Save the basic raw materials in cooperation with recognised bodies.

(4) Provide an advice service to members on salvage problems through the Department of Scientific and Industrial Research.

(5) Provide a link between members for the disposal of surplus materials and equipment by means of a journal known as *Industrial Salvage*.

Members are invited to send any "problems" they have regarding the disposal of their waste material to their local regional council. If the council cannot find a suitable solution immediately, these problems are circulated to other regions, some of whom may have considered similar problems and also to the Department of Scientific and Industrial Research. The replies obtained are transmitted to the members concerned. During the life of this organisation many materials which were regarded as waste have been recovered or treated and put back into useful service.

From the information I have given you I hope you will agree that there is in existence a body whose main object is to deal with problems such as are raised in your article. We are about to embark on a publicity campaign and we hope this will make known our existence to those concerned. I would suggest that it is doubtful whether any Royal Commission could do more than we are doing.

Yours very truly,
R. HAWES DAVISON,
President.

National Industrial Salvage and
Recovery Council,
Hebburn-on-Tyne.
18 November, 1960.

Difficulties of Translation

SIR, A word of thanks to those who have commented on my article "Technical Titles Need Careful Translation" (ENGNG., 30 Sept. '60, p. 462) and to yourself for the privilege of space.

Mr. D. B. Welbourn (28 Oct. '60, p. 569), in suggesting that there is but one meaning of my third example, for the control theory man, tantalisingly does not venture in to clinch his point. In the German I find no ambiguity in the first statement, only inconsistency with the theme; the second is also ambiguous in German.

Two points which Mr. Fritz Ruef mentions (4 Nov. '60, p. 601) are worth emphasis: eminent technologists cannot be assumed to be eminently clear writers and how much a thorough knowledge of the subject helps the translator; some texts cannot be done without it and all are inferior in its absence. "Ship's name" titles have a counterpart in English.

Sir Ernest Gowers, in *The Complete Plain Words*, tilts at the growing use of nouns as adjectives, with the entertaining example:

Food consumption has been dominated by the supply situation, which he neatly renders: People have had to eat what they could get.

A recent illuminating conversion of titles appeared in a publication by FISITA:

L'Amélioration de la Suspension des Véhicules dotés de Suspension Mécanique

which they interpet:

The Levelling of Vehicles equipped with Mechanical Suspension

Die Nivellierung von Fahrzeugen mit Mechanischer Abfederung

but ATZ, not accepting this, gives:

Die Niveauregelung von Fahrzeugen mit Stahlfederung.

We ourselves would tend to think rather of "conventional springs" than "mechanical suspension."

Yours faithfully,
W. D. ARNOT.

Nuneaton, Warwicks.
20 November, 1960.

Dry Bearing Materials

SIR, We have noted with interest an editorial article on "Improved Ptfe/Bronze Bearing Materials" (ENGNG., 7 Oct.'60, p. 466), in which our DU dry bearing material has been mentioned.

In the paragraph which deals with the DU material, a comparison has been drawn with Fluorosint, and we feel that this is not entirely appropriate. The Glacier DU material consists of a steel backing to which is sintered a porous bronze layer, which is in turn impregnated with a mixture of ptfe and lead, which also extends as a continuous phase over the whole surface of the bearing material.

On the other hand, Fluorosint is a reinforced ptfe material, rather more comparable with our DQ type which is machinable, and is supplied in solid and cored bars. It is particularly evident that reinforced ptfe materials do not compare in performance to Glacier DU, when it is considered that the DU type of material is capable of withstanding *pv* factors as high as 33,000 which is more than twice the figure mentioned in your article. Should "accidental" lubrication be present, figures considerably in excess of those mentioned are possible. However, this would depend on the measure of the liquid present and other relevant factors.

A further point which occurs is that you speak of cheaper materials which are available in the form of the conventional porous bronze oil-retaining bearings, which you say are for normal dry applications. We would disagree with you on this point, since oil-impregnated sintered bronze cannot be considered as dry, as they still permit in many cases the contamination of products passing near them which has been eliminated completely when users employ the Glacier dry bearing materials. Bearing lives of 1,000 hours, though useful in many cases, are very much below the figure that can be achieved by our DU material, and in very many applications, customers have installed DU bearings some years ago, and since the *pv* factor was appropriate, have been running ever since, without any need for replacement. In fact, cases where DU has performed satisfactorily for two years or more (20,000 hours) are by no means uncommon.

Yours faithfully,
I. H. ONSLOW,
Contracts Manager—Special Products.

The Glacier Metal Company Limited,
Wembley, Middlesex.
9 November, 1960.

Events in Advance

Royal Smithfield

WIDESPREAD interest will undoubtedly be aroused by the very full range of mechanised farming equipment which will be on show at this year's Royal Smithfield Show and Agricultural Machinery Exhibition, to quote in full the new style and title by which the "Smithfield Show" is in future to be known.

Since Britain can reasonably boast of possessing the most highly-mechanised farming system in the world and can claim to export more farm tractors and machinery than any other country, this annual indoor agricultural exhibition naturally has a considerable overseas appeal. It is noteworthy that last year's event, in addition to obtaining over 70,000 paid attendances, attracted more than 2,200 overseas visitors.

This year's show will be held at Earl's Court, London, SW5, from 5 to 9 December and is being organised by the Smithfield Show Joint Committee, Forbes House Halkin Street, London, SW1. In the livestock side, well over 1,300 live cattle, sheep and pigs will be on show, as well as nearly 400 beef, lamb, pork and bacon entries in the carcase section. The exhibition is open daily from 9 a.m. to 6 p.m. and the general public are admitted.

Exhibitions and Conferences

Boat Show, Fifth Annual South California.—Fri., 6 Jan., to Sun., 15 Jan., 1961, in Los Angeles. Organised by the Southern California Marine Association, 630 South Kenmore Avenue, Los Angeles 5, California, USA.

Upper Midwest Auto Show.—Fri., 6 Jan., to Sun., 15 Jan., 1961, in Minneapolis. Organised by Max Winter Attractions, 620 Hennepin Avenue, Minneapolis 3, Minnesota, USA.

Toy Fair, Twelfth International.—Sat., 7 Jan., to Fri., 13 Jan., 1961, at the Grand, Cairn, Majestic, Old Swan and Crown Hotels, Harrogate. Apply to the secretary, Harrogate International Toy Fair Ltd., Finsbury Court, Finsbury Pavement, London, EC2. Tel. MONarch 8921.

Automotive Engineering, International Congress and Exposition.—Mon., 9 Jan., to Fri., 13 Jan., 1961, at Cobo Hall, Detroit, Mich., USA. Theme: "Ground and Flight Vehicles of Today and Tomorrow." Organised by the Society of Automotive Engineers, 485 Lexington Avenue, New York 17, USA.

Textiles Exhibition, International (INTERSTOFF).—Mon., 9 Jan., to Fri., 13 Jan., 1961, in Frankfurt. Agents in the United Kingdom: Lep Transport

Ltd., Sunlight Wharf, Upper Thames Street, London, EC4. Tel. CENtral 5050.

Motor Show, National.—Wed. and Thurs., 11 and 12 Jan., 1961, at the Coliseum, New York. Organised by the National Association of Engine and Boat Manufacturers, 420 Lexington Avenue, New York, USA.

Motor Show, 41st International.—Wed., 11 Jan., to Sun., 22 Jan., 1961, in Brussels. Offices of the Show: 22 Rue du Luxembourg, Brussels, Belgium.

Housewares Exhibit, The Independent.—Sun., 15 Jan., to Thurs., 19 Jan., 1961, at the Morrison Hotel, Chicago. Organised by Independent Housewares Exhibit, Inc., 8 South Dearborn Street, Chicago 3.

Housewares Exhibit, National.—Mon., 16 Jan., to Fri., 20 Jan., 1961, at McCormick Place, Chicago. Organised by the National Housewares Manufacturers' Association, 1130 Merchandise Mart, Chicago 54, Illinois, USA.

Physical Society, 45th Annual Exhibition.—Mon., 16 Jan., to Fri., 20 Jan., 1961, at the Royal Horticultural Society's old and new halls, Vincent Square and Greycoat Street, London, SW1. Organised by the Institute of Physics and the Physical Society, 1 Lowther Gardens, Prince Consort Road, London, SW7. Tel. KENsington 0048.

Pressure Vessels, Symposium on Better Design for.—Wed., 18 Jan., 1961, in London. Organised, in collaboration with the British Welding Research Association, Abington Hall, Cambridge (Tel. Linton 357), by the Institution of Mechanical Engineers, 1 Birdcage Walk, St. James's Park, London, SW1. Tel. WHItehall 7476.

Boat Show, Mid-American.—Sat., 21 Jan., to Sun., 29 Jan., 1961, at the Public Auditorium, Cleveland. Apply to the Cleveland Press, Show Office, East 9th Street, Cleveland 14, Ohio, USA.

Gift Show, Washington.—Sun., 22 Jan., to Wed., 25 Jan., 1961, at Willard Hotel, Washington. Organised by Little Brothers Shows, Inc., 220 Fifth Avenue, New York 1, USA.

Sporting Goods Show, National.—Sun., 22 Jan., to Thurs., 26 Jan., 1961, at Morrison Hotel and Palmer House Hotel, Chicago. Organised by the National Sporting Goods Association, 716 North Rush Street, Chicago 11, Illinois, USA.

Canada Farm and Industrial Equipment Trade Show.—Wed., 25 Jan., to Sat., 28 Jan., 1961, at the Coliseum, Exhibition Park, Toronto. Organised by Canada Farm and Industrial Equipment Show Ltd., 40 Wellesley Street East, Toronto 5, Ontario, Canada.

Furniture Exhibition.—Thurs., 26 Jan., to Tues., 31 Jan., 1961, in Paris. Organised by the Salon du Meuble et des Industries de l'Ameublement, 22 Avenue Franklin-Roosevelt, Paris 8.

Home Builders' Annual Convention and Exposition.—Sun., 29 Jan., to Thurs., 2 Feb., 1961, at McCormick Place, Chicago. Organised by the National Association of Home Builders, 140 South Dearborn Street, Chicago 3, Illinois, USA.

Meetings and Papers

British Institution of Radio Engineers

LONDON
"Progress in Microminiature Circuit Techniques for Digital Computers," by D. Roberts, Dr. D. S. Campbell and P. M. Thompson. Computer Group. London School of Hygiene and Tropical Medicine, Keppell Street, WC1. Fri., 2 Dec., 6.30 p.m.

CHELTENHAM
"The Place of the Electric Rocket in Space Propulsion," by Dr. W. A. S. Murray. South Midlands Section. North Gloucestershire Technical College, Cheltenham. Fri., 2 Dec., 7 p.m.

MANCHESTER
"Industrial Television," by I. M. Waters. North Western Section. Reynolds Hall, College of Technology, Manchester. Thurs., 1 Dec., 7 p.m.

Illuminating Engineering Society

BIRMINGHAM
"Production of Light Sources," by H. R. Ruff. Birmingham Centre. Regent House, St. Phillips Place, Colmore Row, Birmingham. Mon., 28 Nov., 6 p.m.

NOTTINGHAM
"The Eye and Artificial Lighting," by W. J. Wellwood Ferguson. Nottingham Centre. Electricity Centre, Carrington Street, Nottingham. Thurs., 1 Dec., 6 p.m.

Institute of Metals

LONDON
"The Origin, Detection and Elimination of Gases in Cast Metals," by Dr. D. V. Atterton. London Local Section. Thurs., 1 Dec., 6.30 p.m.*

OXFORD
Symposium on "Electron Bombardment;" including "Metallurgical Applications of Electron Probe Micro-Analysis," by Dr. V. D. Scott; "Electron Beam Melting," by D. B. Gasson; and "The Theory of Electron Probe Micro-Analysis," by N. Swindells. Junior Members' Evening. Oxford Local Section. Cadena Café, Cornmarket Street, Oxford. Tues., 29 Nov., 7.15 p.m.

Institute of Refrigeration

LONDON
"Positive Displacement Rotary Compressors as Applied to Refrigeration," by E. J. Perry and P. D. Laing. Institute of Marine Engineers, 76 Mark Lane, EC3. Thurs., 1 Dec., 5.30 p.m.*

Institute of Road Transport Engineers

BRISTOL
"Transport in Tripolitania," by H. L. Lyons-Jones. Western Centre. Royal Hotel, Bristol. Thurs., 1 Dec., 7 p.m.

Institution of Civil Engineers

LONDON
Symposium on "Management," comprising papers by Sir Leonard Owen, Professor J. F. Baker, Sir Ewart Smith and Colonel S. M. Lovell. Tues., 29 Nov., 5.30 p.m.*

Institution of Electrical Engineers

BIRMINGHAM
"Radio Communication in the Power Industry," by E. H. Cox and R. E. Martin. South Midland Centre. College of Technology, Gosta Green, Birmingham. Mon., 5 Dec., 6.30 p.m.*

BRADFORD
"Thermistors, Their Theory, Manufacture and Application," by Dr. R. W. A. Scarr and R. A. Setterington. North Midland Centre. Bradford Institute of Technology, Bradford. Tues., 6 Dec., 6.30 p.m.*

MANCHESTER
"Electrical Characteristics of the Argon Arc Welding Process," by J. C. Needham and Dr. L. H. Orton. North Western Utilisation Group. Engineers' Club, Albert Square, Manchester. Tues., 6 Dec., 6.15 p.m.

NEWCASTLE UPON TYNE
"Hovercraft," by D. J. Hardy; and "The M.I." (with film), by F. T. Jones. Informal Meeting. North Eastern Centre. Conservative Club, Pilgrim Street, Newcastle upon Tyne. Wed., 30 Nov., 7 p.m.

Institution of Engineering Designers

LONDON
"The Development of Centreless Grinding Techniques," by A. E. Adams. Thurs., 1 Dec., 7 p.m.

Institution of Engineers and Shipbuilders in Scotland

GLASGOW
"Does Prefabrication Pay?" Information Discussion. Tues., 29 Nov., 6.30 p.m.*

Institution of Heating and Ventilating Engineers

GLASGOW
"A New Look at Hot-Water Pipe Sizing," by E. W. Shaw. Scottish Branch. Scottish Building Centre, 425 Sauchiehall Street, Glasgow, C2. Tues., 29 Nov., 7 p.m.

NOTTINGHAM
"Fan Noise in Ventilating Systems," by B. B. Daly. East Midlands Branch. College of Arts and Crafts, Waverley Street, Nottingham. Wed., 7 Dec., 6.30 p.m.

Institution of Highway Engineers

LONDON
"Lessons Learned on the Design and Construction of Motorways from the Consultant's Angle," by R. F. Earley. Institution of Structural Engineers, 11 Upper Belgrave Street, SW1. Fri., 2 Dec., 5.30 p.m.*

Institution of Mechanical Engineers

LONDON
"Gear Materials and Their Treatment:" Discussion. Automobile Division. Tues., 29 Nov., 6 p.m.*
"Economic Results of Diesel Electric Motive Power on the Railways in the United States of America," by H. F. Brown. Wed., 30 Nov., 6 p.m.*
"The Design of the National Physical Laboratory Standard Hardness Test Machines," by F. C. P. Mason. London Graduates' Section. Wimbledon Technical College, Gladstone Road, SW19. Wed., 30 Nov., 7 p.m.*
"Is Training in Industry Really Integrated with Academic Studies on Sandwich Courses in College of Technology?" Discussion. Education Group. Thurs., 1 Dec., 6 p.m.*

BRADFORD
"Planned Maintenance," by W. Jones. Yorkshire Branch. Institute of Technology, Bradford. Mon., 28 Nov., 7.15 p.m.

BRIGHTON
"Water Supply," by F. H. Green. Southern Branch. King and Queen Hotel, Brighton. Thurs., 1 Dec., 7.30 p.m.*

CARDIFF
"The Future of Air-Breathing Engines in Aviation," by S. G. Hooker. South Wales Institute of Engineers, Park Place, Cardiff. Tues., 29 Nov., 6 p.m.

MANCHESTER
"Liquid Metal Heat Transfer," by Professor W. Hall. North Western Branch. College of Science and Technology, Manchester. Thurs., 1 Dec., 6.45 p.m.

Institution of Plant Engineers and Royal Society of Arts

LONDON
"Architect's Approach to Engineering in Tall Buildings," by Sir Thomas P. Bennett. Joint meeting. Royal Society of Arts, John Adam Street, Adelphi, WC2. Tues., 6 Dec., 6.30 p.m.*

Institution of Plant Engineers

LEEDS
"The Building of a Modern Oil Tanker," by W. S. Brown. West and East Yorkshire Branch. Houldsworth School of Applied Science, The University, Leeds. Mon., 28 Nov., 7.30 p.m.

Institution of Production Engineers

MANCHESTER
"Machine-Tool Development as Seen at Olympia in 1960," by Norman Stubbs. Manchester Section. Manchester College of Science and Technology, Manchester. Mon., 28 Nov., 7.15 p.m.

SHEFFIELD
"Membership Qualifications," by H. W. Hodson. Sheffield Section. Grand Hotel, Sheffield. Mon., 28 Nov., 6.30 p.m.

SHREWSBURY
"Recent Developments in High Production Foundries," by J. D. Berry. Shrewsbury Section. Walker Technical College, Oakengates, Shrewsbury. Wed., 30 Nov., 7.30 p.m.

Institution of the Rubber Industry

MANCHESTER
"Costing in the Rubber Industry," by G. P. Slater. Manchester Section. Engineers' Club, Albert Square, Manchester. Mon., 28 Nov., 6.45 p.m.

Institution of Structural Engineers

LIVERPOOL
"Some Unusual Aluminium Structures," by W. Hamilton. Merseyside Panel. College of Building, Clarence Street, Liverpool. Wed., 30 Nov., 6.30 p.m.

Junior Institution of Engineers

LONDON
Films: "Dounreay Fast Reactor"; "Isotopes in Industry"; and "More for Your Money." Fri., 2 Dec., 7 p.m.*

Liverpool Metallurgical Society

LIVERPOOL
"Low Temperature Brazing," by H. R. Brooker. Department of Metallurgy, The University, Liverpool. Thurs., 1 Dec., 7 p.m.

Operational Research Society

LONDON
"Studies of Labour Turnover in the Coal Industry," by Dr. B. T. Houlden. Royal Society of Arts, John Adam Street, Adelphi, WC2. Tues., 29 Nov., 6 p.m.*

Reinforced Concrete Association

LONDON
"Reinforced-Concrete Construction in the Coal Industry," by C. A. C. Davies. Institution of Structural Engineers, 11 Belgrave Street, SW1. Thurs., 1 Dec., 6 p.m.*

MANCHESTER
"A Report on the Cement and Concrete Association's Visit to South America," by Dr. D. D. Matthews and J. L. Womersley. North Western Branch. College of Technology, Sackville Street, Manchester. Mon., 5 Dec., 6.45 p.m.*

Royal Institution of Naval Architects

LONDON
"Strength of Propellers," by J. E. Conolly. Thurs., 1 Dec. 4.45 p.m.

Royal Society

LONDON
Anniversary Meeting. Wed., 30 Nov., 2.30 p.m.

Royal Society of Arts

LONDON
"Traffic and Parking Problems," by A. Samuels. Wed., 30 Nov., 6 p.m.

Royal Statistical Society

SHEFFIELD
"New Uses of Computers in Statistics," by Professor G. A. Barnard. Sheffield Group. Grand Hotel, Sheffield 1. Wed., 30 Nov., 7 p.m.

Sheffield Metallurgical Association

SHEFFIELD
"Some Applications of Castables and Mouldables in the Iron and Steel Industry," by Dr. R. W. Grimshaw. Refractories Group. BISRA Laboratories, Hoyle Street, Sheffield. Tues., 29 Nov., 7.30 p.m.

Society of Instrument Technology

LONDON
Symposium on "Nuclear Temperature Scanning": including "Temperature-Scanning Equipment for a Large Nuclear Reactor," by C. Hall; and "Temperature-Scanning Equipment for Use in a Nuclear Power Station," by A. G. Bliss, P. G. Davey and F. C. Flint. Data Processing Section. Manson House, 26 Portland Place, W1. Tues., 29 Nov., 7 p.m.*

CARDIFF
"The Application and Selection of Automatic Control Valves," by P. Stone. South Wales Section. Welsh College of Advanced Technology, Cardiff. Wed., 30 Nov., 6.45 p.m.

FAWLEY
"Selection Design and Application of Automatic Control Valves," by P. Stone. Fawley Section. Administration Building, Esso Refinery, Fawley. Fri., 2 Dec., 5.30 p.m.

LIVERPOOL
"Statistics," by J. R. Judd. Liverpool Section. Industrial Development Centre, Manchester and North Western Electricity Board, Liverpool. Thurs., 8 Dec., 7 p.m.

SHEFFIELD
"Instrumentation for Railway Research," by P. H. Mansfield. South Yorkshire Section. The University, St. George's Square, Sheffield. Mon., 5 Dec., 7 p.m.

Television Society

LONDON
"The All-Transistor Receiver: Where Do We Stand?" by Dipl. Ing. A. Landman. Cinematograph Exhibitors' Association, 164 Shaftesbury Avenue, WC2. Thurs., 8 Dec., 7 p.m.

The address and telephone number of the headquarters of each institution are given below. Meetings in the headquarters town are held there unless otherwise stated. An asterisk (*) is placed where it is understood that refreshments are available prior to the time stated.

British Institution of Radio Engineers, 9 Bedford Square, London, WC1. (MUSeum 1901)
Illuminating Engineering Society, 32 Victoria Street, London, SW1. (ABBey 5215)
Institute of Metals, 17 Belgrave Square, London, SW1. (BELgravia 3291)
Institute of Refrigeration, New Bridge Street House, New Bridge Street, London, EC4. (CENtral 4694)
Institute of Road Transport Engineers, 69 Victoria Street, London, SW1. (ABBey 6248)
Institution of Civil Engineers, Great George Street, London, SW1. (WHItehall 4577)
Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, WC2. (COVent Garden 1871)
Institution of Engineering Designers, 38 Portland Place, London, W1. (LANgham 8847)
Institution of Engineers and Shipbuilders in Scotland, 39 Elmbank Crescent, Glasgow, C2. (Central 5181)
Institution of Heating and Ventilating Engineers, 49 Cadogan Square, London, SW1. (SLOane 3158)
Institution of Highway Engineers, 47 Victoria Street, London, SW1. (ABBey 3891)
Institution of Mechanical Engineers, 1 Birdcage Walk, St. James's Park, London, SW1. (WHItehall 7476)
Institution of Plant Engineers, 2 Grosvenor Gardens, London, SW1. (SLOane 0469)
Institution of Production Engineers, 10 Chesterfield Street, London, W1. (GROsvenor 5254)
Institution of the Rubber Industry, 4 Kensington Palace Gardens, London, W8. (BAYswater 9101)
Institution of Structural Engineers, 11 Upper Belgrave Street, London, SW1. (SLOane 7128)
Junior Institution of Engineers, Pepys House, 14 Rochester Row, London, SW1. (VICtoria 0786)
Liverpool Metallurgical Society, Greenhithe, Grosvenor Road, St. Helens, Lancs. (St. Helens 5879)
Operational Research Society, 64 Cannon Street, London, EC4. (CITy 1800)
Reinforced Concrete Association, 94-98 Petty France, London, SW1. (ABBey 4504)
Royal Institution of Naval Architects, 10 Upper Belgrave Street, London, SW1. (SLOane 4622)
Royal Society, Burlington House, Piccadilly, London, W1. (REGent 3335)
Royal Society of Arts, John Adam Street, Adelphi, London, WC2. (TRAfalgar 2366)
Royal Statistical Society, 21 Bentinck Street, London, W1. (WELbeck 7638)
Sheffield Metallurgical Association, 64 Crescent Road, Sheffield 7. (Sheffield 52865)
Society of Instrument Technology, 20 Queen Anne Street, London, W1. (LANgham 4251)
Television Society, 166 Shaftesbury Avenue, London, WC2. (TEMple Bar 3330)

Inflatable Dam Controls a Flooding River

Successful flood water control of a river has been obtained by the Los Angeles (California) Department of Water and Power by the installation of an inflatable neoprene tube as a dam.

The Los Angeles River is one which shows a wide variation in winter and summer flow and for years attempts have been made to even out the situation by installing a temporary wooden dam across the river during the low water season. The dam diverts the river water, which otherwise would flow out to sea, into nearby deep gallery spreading grounds. There the water filters through the soil, purifying itself in the process. Later it is pumped out of the underground basin and into the city's water distribution system.

However, each winter the wooden dam, which was designed to wash out under flood conditions, would be swept away after the first heavy storm. Consequently, during the time it was in most plentiful supply, no water was diverted for future dry spells. This functional deficiency, plus the cost of rebuilding the dam each year, stimulated an engineering study to develop a better water diversion technique.

It was argued that a permanent barrier that would temporarily collapse and lie perfectly flat on the river channel during flood stages would solve the problem. Proceeding on this premise, a flexible tubular dam was designed that could be inflated with water to a predetermined height but, through a syphoning arrangement, would gradually deflate as the weight of river water flowing over it increased during flood stages. Then, after the flood water subsided, it could be reinflated for normal operation.

For such a device to work, it had to be made from a material tough enough to withstand the abrasion of water-borne sand and rocks, yet flexible enough to collapse completely flat so that debris would not become entangled and form an impromptu dam. The material selected was Du Pont neoprene reinforced with nylon fabric, which has excellent mechanical and weathering characteristics. Its abrasion resistance was yet to be determined.

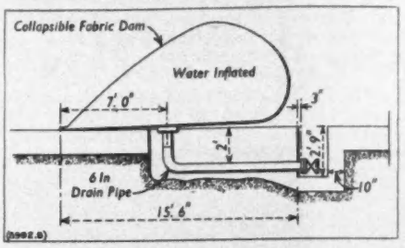
This and other properties of the neoprene coated fabric were studied in a practical experiment. A 20 ft long tubular section was fabricated from the neoprene coated material and installed at one end of the wooden dam with appropriate syphoning controls. The wooden dam was strengthened with knee braces, designed for quick pullout to collapse the dam if a flood threatened. This was done to allow the test dam to be subjected to severe storms and the consequent abrasion from sand, rocks and debris.

The experimental dam was completed in late 1957 and there were many severe storms that winter. Consequently, there were ample opportunities for testing the principle of automatic collapse and for observing the strength and abrasion resistance of the neoprene-nylon fabric. On both scores the trial installation proved to be a success.

Based on this successful demonstration, plans were made for erecting a full-sized collapsible dam across the river. A neoprene-nylon tube, 150 ft long by 30 ft in circumference and $\frac{1}{8}$ in thick, was made for the Department of Water and Power by a rubber manufacturer. Fabrication of the tube was done by lap splicing the fabric and then cementing with a newly developed Du Pont neoprene base adhesive which air cures at room temperature.

Installation was done by the Department's own work crews, using stainless steel bolts set into the concrete floor of the river channel to anchor it. The flexible dam was also bolted on each side to the vertical concrete walls of the channel at a height of 10 ft, leaving a length of 130 ft along the river bottom.

Early in the spring of 1959 the dam was inflated, subjected to a series of tests, and put into regular operation. The Department is quite pleased with its performance to date. It has been estimated that each year this dam will recover about 2,000 acre-ft of water valued at some $75,000. Savings like these certainly should make this unique dam design of interest to other communities in all parts of the world which may have similar problems, and the precise regulation of the flow that is obtained will interest other irrigation and flood control authorities.



(Above) Profile of the inflated neoprene fabric dam and cross-section of the syphon installation which regulates the height of the dam according to the flow.

(Right) The dam can be inflated in 25 minutes. It is fastened to the river bottom and the sides of the channel with stainless steel bolts.

Prefabricated Bridges Go Overseas

Engineers of British Insulated Callender's Construction Company Limited have been supervising some interesting installations of Callender-Hamilton bridges in widely spaced Commonwealth territories. These bridges are of prefabricated steelwork that is protected by galvanising to eliminate site painting. The connections are all made with high strength friction bolts of $\frac{1}{2}$ in to 2 in in diameter, passing through plates from $\frac{1}{16}$ in to $\frac{3}{4}$ in in thickness to form either single-lap or multi-plate butt joints. Many years of experience, with bridges spans ranging from 20 ft to 300 ft, have shown that there is no appreciable movement of the connections once they have been tightened.

On the new Aklavik Highway in the Yukon four spans have attracted considerable attention as Canada's northernmost bridges. The first span of 60 ft was erected at Benson Creek in only four days by a crew of eight local men. Another Canadian order is for the Government of Newfoundland, who have ordered two spans each 150 ft long to provide a 24 ft clear roadway across the river at Sops Arm. The illustration shows an example from New Zealand where a five-span bridge has been erected at the Waipapa hydro-electric station.

Erected under very different conditions there is the three-span railway bridge crossing the Mkondoa River in Tanganyika on the line from Kilosa to Mikumi. Construction was carried out by African labour with little or no previous experience of steelwork erection. The Public Works Department of Tanganyika are themselves constructing both deck and through-type road bridges with the company's equipment.

There was a good example recently in Nigeria of the value of this type of bridging for emergency replacement. The existing bridge at Shagamu on the main Lagos-Ibadan Road was damaged and put out of commission by a very heavy forest tree which was accidentally felled across it. A replacement bridge was sent out immediately from stocks in the UK and the permanent roadway restored in a short space of time.

Callender-Hamilton bridging is also being used in connection with the Mangla Dam Project in Pakistan. One span of 336 ft and two of 150 ft will carry a 26 ft wide roadway over the Jhelum River to provide access to the civil works.

A Callender-Hamilton deck type bridge erected at the Waipapa hydro-electric station in New Zealand.

Building Up and Down Together

Two-way building—construction proceeding simultaneously from the roof downwards and from the ground floor upwards—is being used by Leslie and Company Limited to quicken work on the four-storey department store in Argyle Street, Glasgow, for the House of Fraser. The

Positioning shutterwork from the roof.

technique is expected to shorten the construction period by between one and two months.

As soon as the steel frame was up the roof was put on and waterproofed to give protection to the other work. Concreting of the top floor began while building from the ground floor upwards went on in the usual way. As each floor is concreted, building of brick walls and the installation of essential services are being carried out from the top floor downwards and from the ground floor upwards simultaneously. The work has been scheduled to ensure maximum time saving repetition of processes from floor to floor and the wall beams were designed to carry brick walls without support from below.

The illustration shows one of the preconstructed shutters for the floor slabs being lowered by winch from the completed concrete roof to the third floor ready for fixing and then placing of the concrete. The first floor, which had already been completed in the conventional way—working from the ground floor upwards—is to be seen through the steel frame of the second floor.

The contract is being carried out by Leslie's Lesway division of Sauchiehall Street, Glasgow. The consulting structural engineers are George Davie, Crawford and Partners of Glasgow, and the architects are Gordon Jeeves of Catherine Place, London, SW1. All mechanical services are being designed by Winton Thorpe and Tunnadine of Victoria Street, London, SW1.

Prestressing by Electric Heating

Prestressing of concrete reinforcement by electric heating has been brought into general practice in the USSR. The method adopted is particularly useful for relatively short members such as floor slabs and roof panels. It is claimed that the equipment required costs only one-tenth of the conventional jacking equipment and that the prestressing times are much shorter; moreover, the plant is easily transported and is suitable for both factory and site fabrication of members.

The steel rods are cut to length, straightened and fitted with anchors of a very simple pattern at both ends. They are then ready for heating, following which they are transferred in the hot state to the moulds, fixed into position by the anchors and allowed to cool, so generating the prestress. The steels used are mainly hot-rolled alloy steels with deformed surfaces, though cold-formed steels are also used. Heating of the rods to a temperature of between 300 and 400° C takes some three to five minutes and heating is restricted to the central portion, so that both ends of the rods (40 to 60 cm) remain cold. This permits the rods to be transferred and placed in the moulds manually. Cooling in the moulds for 15 to 20 minutes lowers the temperature to about 80° C and creates a prestress of between 3 and 5 tons per sq. cm (about 37,500 to 62,000 lb per sq. in).

Power consumption is said to be 1½ units for each cubic metre of reinforced concrete.

Coyne Technique Adopted in Britain

Increased water consumption in Falmouth has necessitated raising the crest level of Argal Dam to enlarge its capacity. A £61,000 contract for raising and stabilising the dam has been awarded to the Cementation Company; Rofe and Raffety, of London, are the consulting engineers to the Falmouth Borough Council.

In stabilising the heightened structure, Cementation are introducing a method new to this country—the Coyne method of cable anchorage—which they have previously used overseas. This technique has been accepted as the most economical means of stabilising the dam.

The dam is to be raised by about 11 ft in two lifts, the first of 6 ft 6 in. When the first lift has been completed, 47 high-tensile steel cables will be inserted into holes drilled through the dam, anchored into the rock below, and stressed to a working load of 200 tons. The stressed heads of the cables will then be permanently incorporated in the second lift of concrete. Work is in progress and completion is due early in 1961.

The method can also be used for stabilising such structures as docks, sea walls, lighthouses, cofferdams, caissons and tunnel roofs.

Cementation have also secured the contract for cable anchorages on the new Forth suspension bridge. The design of the bridge is such that vertical cables are required through the legs of each of the side towers to compensate for stresses applied by the main bridge cables. In all there will be 80 high tensile steel cables, each stressed to a working load of 120 tons, anchored into the rock. The Coyne technique will also be employed for fixing these cables and the work is expected to complete by mid-February, 1961.

New Reservoir for Edinburgh

The Edinburgh Corporation is to construct a reservoir on the Fruid Water, an upper tributary of the Tweed which is already partially developed for the supply of water to the city. The proposed scheme, which will increase the Corporation's resources from 38 million gallons per day to over 45 million and is estimated to cost £1,300,000, and is the largest waterworks which the Corporation has undertaken since the Talla scheme at the beginning of this century.

The consulting engineers for the scheme will be Robert H. Cuthbertson and Associates of Edinburgh. It is proposed that the construction of the reservoir commence in 1962 and be completed in 1966.

The reservoir, which will be formed by an earthen dam 75 ft high, will be 2 miles long and have a capacity of over 2,000 million gallons. The natural catchment area of 5,300 acres will be increased by trapping into the reservoir two smaller tributaries of the Tweed through aqueduct tunnels. Preliminary site investigations have been carried out under the supervision of the consulting engineers. Soil tests were carried out at the engineering department of Manchester University under the direction of Dr. Peter Rowe, Reader in Soil Mechanics.

The scheme is a further step in the former Edinburgh and District Water Trusts' scheme for the development of the upper Tweed as a source of supply originally adopted in 1894. The first stage of the development was finished with the completion of the Talla Reservoir in 1905. The second stage, comprising the partial development of the Menzion and Fruid Waters by diverting these streams into the Talla Reservoir through a 1¾ mile tunnel, was completed in 1952.

The aqueduct tunnels which were constructed between Talla and Edinburgh were made large enough to convey the whole of the water estimated to be obtainable from the upper Tweed and the Fruid Scheme will not entail any enlargement on that account. This foresight by the Corporation predecessors and the fact that the Fruid Valley is a very favourable site for a reservoir provide a relatively economical increment to the city's water resources.

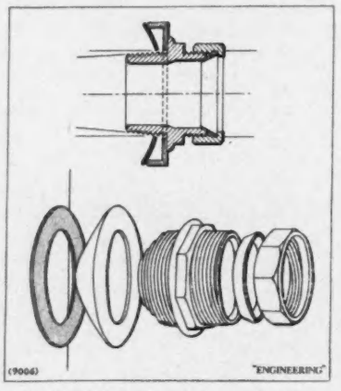
Waste Pipe Connections

A waste connector which will speed up and simplify the installation of a stack drain made with pitch fibre pipe is being introduced by the Key Engineering Company Limited, Larkfield, near Maidstone, Kent.

With the new fitting, to be known as the Key-Conex "Tapertite" waste connector, it will be possible to make 1¼ in and 1½ in waste connections anywhere on the down pipe, before or after installation, eliminating fitting from inside the pipe.

Based on the standard Key-Conex waste connector fittings, the "Tapertite" has a modified shank with no flange. The shank has a 5° taper and deep-cut threads (11 tpi). All that is necessary to fit the new connector is to cut a hole to the required size, 1¼ or 1½ in diameter, with a tank cutter.

The connector is then screwed home until a locating arrow on the nut matches a similar arrow on the saddle. This indicates that the end of the shank (which is curved to match the



The Key-Conex waste pipe connector.

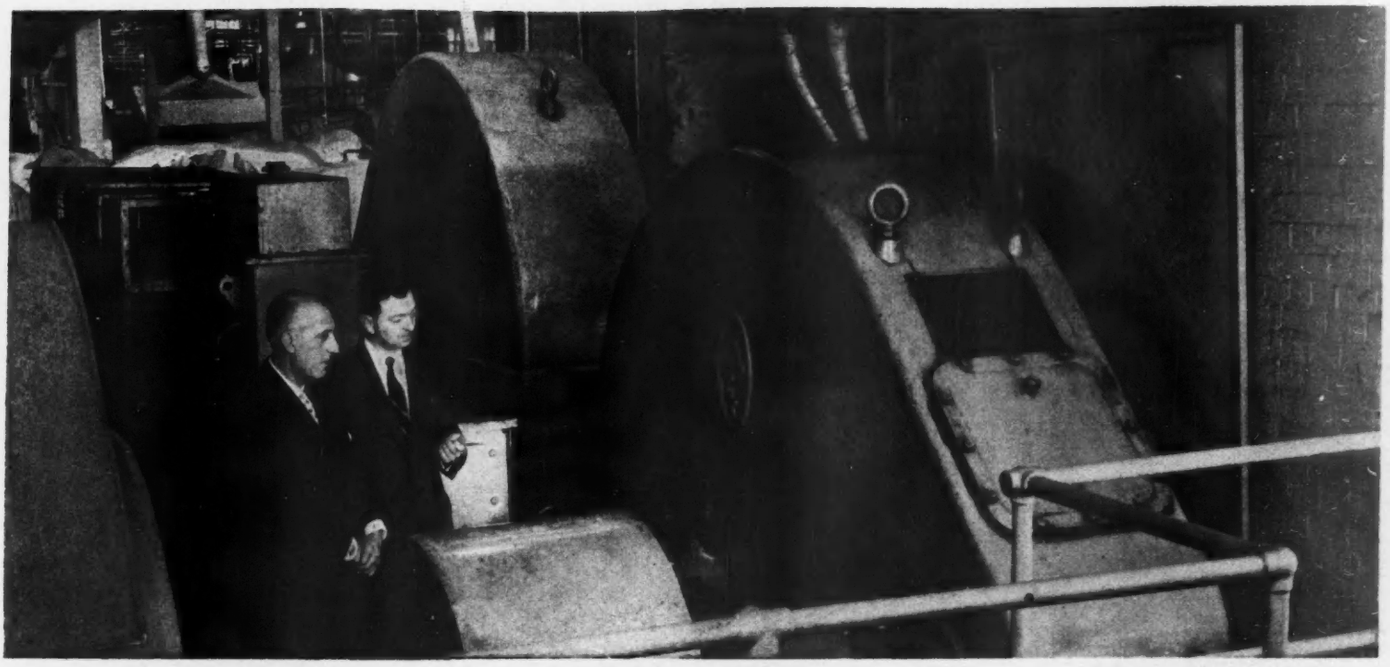
wall of the 4 in pipe) is flush with the pipe wall. There is thus no internal projection. The connector is absolutely watertight, even when only two threads are engaged in the pipe wall. The waste pipe is then connected in the usual way with the compression ring assembly.

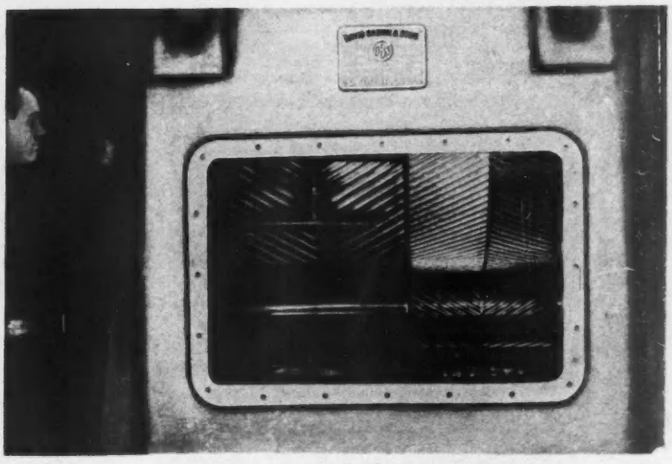
If at some later stage in the development of the building it is necessary to alter the waste connections, it is a simple matter to unscrew the Tapertite connector, blank off the hole, and re-use where required. This means that specials are not required at any stage of the contract, or later development.

With the new connector, and using the standard Key pitch fibre pipes in 8 ft lengths, it is possible to erect a stack in much less time than would be needed for traditional materials. Additional sizes of the Tapertite are being developed.

The new connector (patents applied for) was shown for the first time at the Key stand at the Public Works Exhibition, Olympia.

Dunlop choose Regent lubricants for these gears!





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(Inset) The 600 H.P. Double Reduction Speed Reducer in this picture at the Dunlop factory in Birmingham is driving a Mixer. Dunlop have found Regent Oil ideal for the efficient lubrication of these gears.
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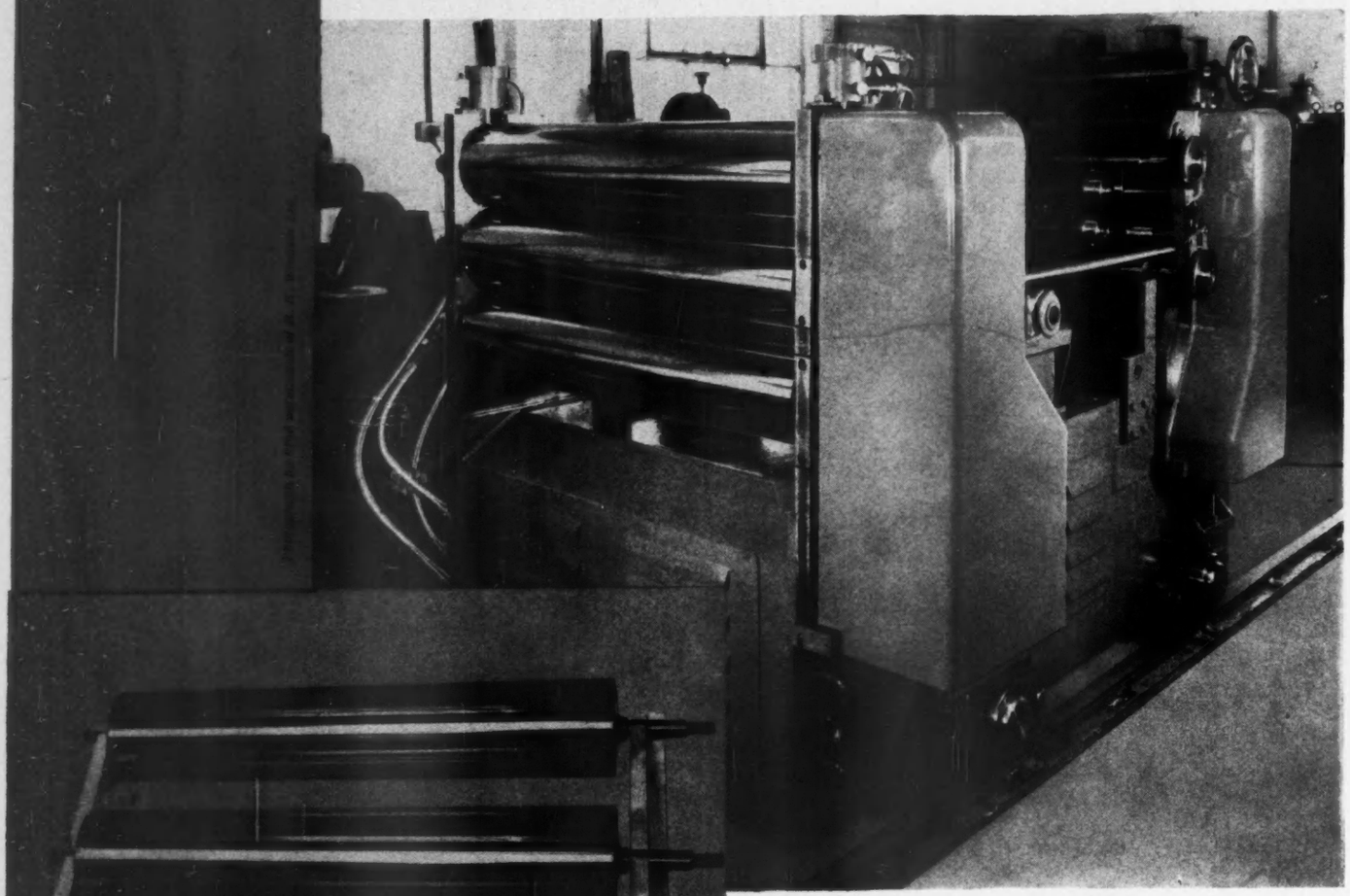

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TGA 161A

Human Element

Raising the Leaving Age From Technical Schools?

PERHAPS the most serious single element to emerge in the recent House of Commons debate on education was the reference by Sir David Eccles, the Minister of Education, to the way in which the growing use of day-release schemes for adult education has slowed right down.

More and more, it has been recognised in the industrial and educational worlds that the day-release student has an immense advantage over the boy struggling with a five-day-a-week job and evening classes. So conversion of employers to the better way of ordering these things would account for some of the past increases in the figure of students using day-release facilities. It would also mean that the supply of students to swell the figures of those on such courses was not bottomless and would at some time dry up.

But this is only part of the story. As many people have said, and the Minister of Education has again repeated, there is an "urgent need for more and better technicians." This ought to mean not only that students who would have been engaged on purely evening-class studies would make use of day-release arrangements, but also the generation of new bodies of future technicians and engineers.

The slowing down of the rate of increase in the numbers of those on day-release instruction is sufficient evidence that this is not happening.

Important Changes

Some time next month the Government is to announce far-reaching changes in the field of technical education. Every industry, except agriculture, will be concerned and improved training facilities for as many as half-a-million students are involved.

What faces the Ministry of Education is a clear choice between leaving almost the whole burden of further technical education as the responsibility of industry or substantially going over to giving full-time technical training to some young people, before they go into industry at all.

And this would not be so difficult as some critics would inevitably make it sound. Already the employment, or otherwise, of the large body of school leavers is anxiously watched each year. Full-time technical education for a useful proportion of them would defer the problem for at least two years and directly increase the supply of potentially skilled men.

£40 Million for Standardisation Scheme

Over the next ten years some one-and-a-half million users of electricity are going to find the area electricity boards carrying out modifications to their household appliances—free of charge.

This is because about a tenth of the 16 million electricity consumers in England and Wales are not yet standardised. That is, they are not yet supplied with the national standard of 240 volt alternating current. In total, the 12 electricity boards involved have programmes that will cost £40 million in the coming ten years.

When a voltage is changed in an area there is an obligation on the board to do the modifications to household equipment concerned without charge to their consumers.

The £5 million scheme of the Southern Electricity Board to standardise the voltage for 180,000 consumers over the next few years has now been approved. More than three-fifths of the money will be spent in the Southampton and Bournemouth districts.

Trade Union Problems In EFTA

One of the most interesting features of the recent EFTA Conference were the views of the trade unionists present given in a report from the Commission on Labour and Social Problems. Chairman of the Commission was Mr. J. A. Birch, who is also chairman of the economic committee of the TUC.

The report makes interesting reading. Freer trade must be combined with full-employment. If there had to be a choice then the trade unions would go for full-employment every time. Free trade in Europe must be seen against the background of the threat of Communism and the need to allow low-cost manufactured goods into the European market. It is not possible to give the Asian and African countries loans and grants to start up industries and then refuse to buy their products.

In Europe, says the report, mass-unemployment is now politically impossible. But the prevention of regional unemployment must be primarily a problem for national governments. Wider problems could however be dealt with in the OECD. Training and re-training are one of the important factors in allowing structural unemployment. Not every displaced worker can hope to find a job in the same trade or outside it at the same wage. In Scandinavia there is cooperation in measures to transfer workers to other jobs and other areas.

Labour Movements

One problem that has been much discussed in connection with European economic integration is mobility of labour. The report thought that international mobility of labour was more welcome to the employers than the trade unions. In the Common Market transfers of labour were now arranged by national governments. German firms for example had to recruit Italian labour not directly but through Government agencies in Italy. Inside the seven EFTA countries movements of labour were not considered very likely. Portugal, the only country with surplus manpower, was regarded as too remote from the other members for any shift of workers to take place.

The Common Market has a Social Fund to provide for the adjustments and adaptations that follow increased competitition due to freer trade. The trade unionists would like to see a similar institution within EFTA. Such a Fund would, however, be complementary to national labour supply policies.

Another of the Common Market rules, that of harmonisation of social policies, was discussed. This question the report thought should be solved by negotiation not regulation. There was another view, that fringe benefits should be harmonised to help the workers in the poorer countries.

All told the trade unionists were against international planning as practised in the Common Market. At the same time they wanted to see more adaptability in the national economies of the Seven and more mobility in their labour markets. Above all the report stressed the need for the trade unions to be consulted in all EFTA decisions likely to affect their livelihood.

Far from EFTA being a laisser-faire organisation, the trade unionists at the Conference clearly believed that deliberate policies would be needed and that they wanted to have a hand in deciding what these should be.

Labour Party into Trade Union Lobby

Simultaneously last week two potentially influential developments came through clearly on the political screens.

Trade union representatives and trade union favoured socialists came through more strongly than before in the new membership of the Labour Party shadow cabinet. Although the late challenger, Mr. Harold Wilson, made a speech shortly after the resumption of Parliament, attacking the Government's economic policy, which may properly be described as brilliant by any House of Commons standards, he slipped a long way down the popularity poll, which is what the shadow cabinet results may be considered to be.

Ancient Weapons

After the defection of Ramsay MacDonald the trade unions rallied round and saved the Labour Party—a view expressed by more than one stalwart of the trade union right wing leadership. Now it appears that something of a similar movement is being attempted. But is it any good fighting this particular war with the weapons of the last but one?

Fewer and fewer people think of themselves as workers. Those that do, do not give Labour a hundred per cent support at the ballot box. The largest increase in numbers and the steadiest employment in this country, as abroad, is in service and supply industries, where the tendency of the run of the mill employees to think of themselves in trade union terms is notably absent.

Rapid Rally

So a quick rally round the trade union flag, while potentially a good thing if it were to lead to a clearer expounding in public life of the views and aspirations of this part of the community, and perhaps to more effective leadership of its members in industry, is on the face of it also a certain way to lead Labour into the position of a minority party, representing a minority interest.

This could explain something of the emergence of stronger Liberal losing candidates in the recent by-elections. There is no tradition of one party government in Britain and if one party cannot offer opposition then another is likely to receive the attentions of the electorate.

But a fighting rally by the Labour Party on matters of the good government and the country's economy could still channel the growing concern at our poor trading position.

Lord Beveridge on Inflation, Crime and Cities

There is just as much wrong with the Affluent Society of certain nations in the present as there was with the Poor Society of many more nations within living memory.

Lord Beveridge, perhaps the greatest living British social pioneer, explaining this simple fact (obvious enough once it has been stated) to a recent lunch of the Industrial Welfare Society, picked out three of the things that are wrong in particular.

First the man who is as expert as any man in questions of insurance looked at inflation. What he had to say has been said many times before, that it hits old people, destroys their savings and devalues their pensions. Lord Beveridge, who himself retired from paid employment in 1944, explained the fact that he is still able, 16 years later, to go into the Reform Club, by recalling that he had refused to take a pension but had received a lump sum—which he had put into equities.

It was up to the employers' and the unions to make a joint effort to find a cure for inflation. If this was not done inevitably the State would have to step in with price control and a lot of other things that would increase the number of civil servants.

A second threat came from violence and crime. This was in fact a continuance of the conditions set up by world wars and the idea of taking what one desired by force.

The state of the traffic in Oxford always seems to spark off a degree of public interest out of proportion to the number of vehicles passing through the city or the length of their delays. Lord Beveridge brought up failure to control the growth of cities as his third point. He described the failure of the Government to do anything worthwhile about relieving the Oxford traffic as one of his chief grievances.

Lord Beveridge disclaims the office often thrust upon him of Father of the Welfare State. Perhaps it is a measure of the success with which the poverty remembered by the 82-year-old peer has been eradicated, that it is possible for a great reformer to dwell at length on the traffic problems of one English city.

Cube Framework of Many Dimensions

The path of even the inventor who achieves some official acclaim is neither smooth nor direct.

Mr. Wilfrid Trask, who lives in Brook Drive, Lambeth, South East London, won an award at this year's Concours International d'Inventions de la Foire de Paris for his entry which was named for the contest—Cubes à plusieurs dimensions.

A British Government Ministry has since been studying the drawings and specifications of Mr. Trask's "Cubic framework of many dimensions."

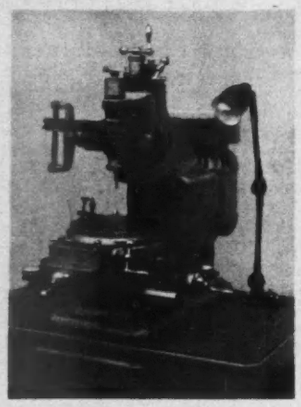
JIG BORER

Light Precision Work

THE Mark III BCA jig borer is designed as a low cost machine for light precision work.

The machine can be supplied for bench mounting or on a pedestal as illustrated. It has a spindle head that swivels 30° either way and is fitted with a scale graduated in degrees. The head runs in dovetail slideways and has a vertical scale graduated in inches. The maximum distance from spindle to table is 8 in. A micrometer dial on the head top is graduated in thousandths, and a fine feed mechanism is incorporated.

The rotary table has protected worm gear and the worm spindle is graduated in steps of 2 minutes. It is mounted on longitudinal and transverse slides giving movements of 8 in and 5 in respectively. The table itself is 8 in diameter. Power to drive the spindle is supplied from a 2-speed ½ h.p. motor running from three phase mains, and the total speed range of the spindle using the cone pulleys in combination with the motor speeds is from 300 to 3,250 r.p.m.



with a possible choice of 11 steps.

All lead screws are fitted with ball thrust races for smooth operation and the slideways have adjustable gibs. The maximum capacity of the spindle is for a ⅝ in collet. *Kine Engineering Company Limited, Multico Works, Salfords, Redhill, Surrey.*

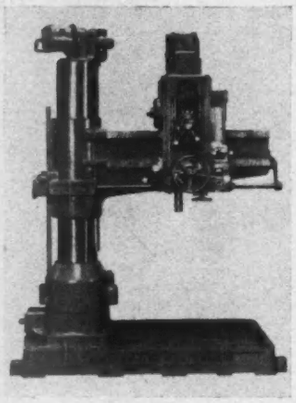
RADIAL DRILL

2 in Capacity

AVAILABLE in a range of sizes with spindle radii from 3 to 5 ft, a new radial drill has a capacity in mild steel of 2 in.

The E2 head is powered by a 5 h.p. motor mounted on ball bearing rollers on the arm. Traverse is by hand wheel and rack and pinion. There are 18 spindle speeds from 1,560 to 25 r.p.m. and 9 power feeds from 280 to 24 cuts per in. In addition there are fine and quick hand adjustments to the spindle. The double lever is claimed to allow sensitive drilling of small holes.

Start, stop, reverse and inching are under master control at the bottom right corner of the head. An indexed dial sets the automatic trip for the desired feed, any depth from 0 to 14 in being possible. On the standard machine the head is locked by a lever on the left, but power locking can be supplied as an extra. Whether power or hand locked, the arm can be raised or lowered on the column so that the spindle is maintained in true position over the



hole, allowing tool changing without repositioning.

A 1½ h.p. motor drives the elevating mechanism through an oil immersed worm and wheel. Positive trips guard the top and bottom positions. *A. Kitchen-D. Walker Limited, Hexagon Works, Pellon Lane, Halifax, Yorkshire.*

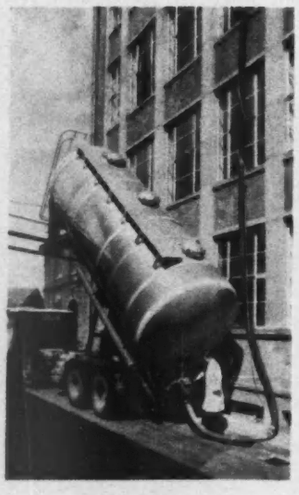
BULK TANKER

Pneumatic Ejection

LARGEST of the Pneumajector tankers is a vehicle with a capacity for 15 tons of flour.

Mounted on a Guy Invincible chassis the light alloy container has a capacity of 1,174 cu. ft. The single compartment is 23 ft long by 8 ft diameter and is secured to the tipping subframe by metal bands. Pilot U7 twin-ram underfloor tipping gear is used, and the vehicle is in service with Pointers Transport Services of Norwich.

Three overhead loading hatches are fitted. To avoid the problem of tipping the full load there is a blown discharge outlet at each end. That at the front is used to discharge approximately one-third of the load without resort to tipping, usinga Wellworthy blower. The remainder of the load is then discharged from the rear outlet by a combination of tipping and blowing. In trials the full 15 tons was discharged through a run of 4 in pipe, 20 ft being horizontal, 40 ft vertical and 20 ft at 45°, in under 45 minutes. On another occasion the



load was discharged through 75 ft of 3 in pipe to a height of 50 ft in 25 minutes. *Bonallack and Sons Limited, Raycocke Road, Basildon, Essex.*

COMPRESSION TESTER

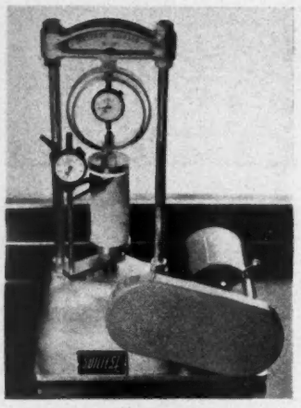
For Small Parts

COMPRESSION tests on small parts can be carried out on a new lightweight machine model U-163.

Both compression and crushing tests can be carried out on small parts made of metal, ceramic, wood or plastics, as well as on such items as paper boxes, containers and springs. The machine is designed for use in the factory for general tests and also in the laboratory. Another use is in colleges for studying effects of loading.

The machine is made of aluminium, so it is light to handle. It is compact and requires only a square foot of bench or desk space. The standard platens supplied will take specimens up to 3 in diameter and 8 in high. Other sizes can be accommodated by using larger platens which are available as extras. Load is applied to the specimen by a variable speed electric motor and the rate of loading can be adjusted by a hand lever arrangement.

Test loads as applied are measured accurately to 0·1 lb by the sensitive



proving ring assembly mounted above the specimen. This has a load capacity up to 500 lb. Mounted on the left is a dial gauge to indicate the strain of the specimen during the test. The position of the gauge is adjustable to suit the specimen. *Soiltest Inc., 4711 W North Avenue, Chicago, Illinois, USA.*

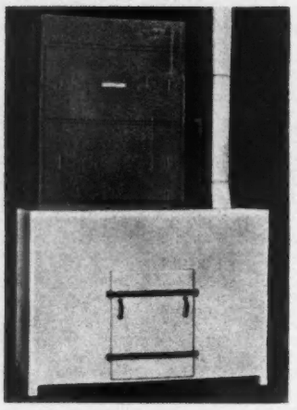
DUST COLLECTOR

Bulky Materials

THE latest range of Unimaster dust control units provides particularly for bulky and granular materials.

A conventional dust control unit has an angular flange at the base of the filter chamber. This allows the unit to be mounted on large storage containers which can be made up from any convenient material such as timber, chip board or sheet steel, always provided they are airtight. The one in the illustration is made from chip board. It holds a large quantity of material and has a door in the front for emptying. The unit is the Unimaster 250 H.

A particular application is to the woodworking industry where the standard 4 cu. ft container is too small to accommodate any reasonable quantity of wood chippings and sawdust. Another is for cases where sacks are emptied by tipping into a floor opening and for this a patent sack tipping attachment is available. The type H unit can also be fitted on top of hoppers with rotary valves for tailing the collected dust back into conveying



systems, and is so used in the flour and provender industries.

Units comprising the type H series are made in sizes with 70, 100, 150, and 250 sq. ft of filter area and with fan capacities up to 2,000 cu. ft per minute. *Dallow Lambert and Company Limited, Thurmaston, Leicester.*

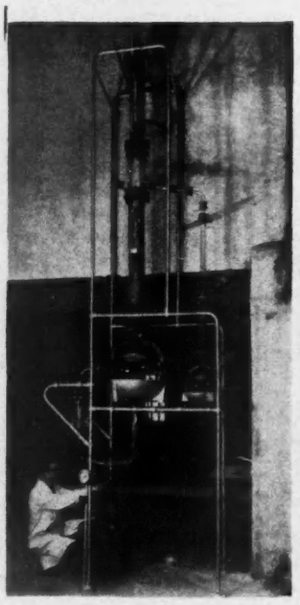
STILL

Steam or Electrically Heated

A NEW all-glass still that can be heated either electrically or by steam has a rated flask capacity of 100 litres.

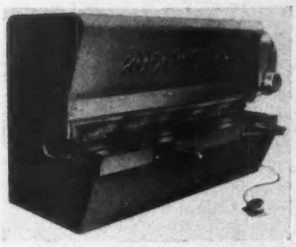
Charging of the still can be by atmospheric operation or by vacuum, and the reflux can be controlled manually or electrically as required independently of the method of heating. The coolant supply is connected to the coil by flexible tubing, and for maximum cooling a supply at 30 lb per sq. in is desirable.

With steam heating the flask stands in a coil battery through which the steam circulates. The maximum steam operating pressure is 50 lb per sq. in. For electric heating a mantle type heater is used and temperature is controlled by thermostat. Boil-up rates for steam using a 5 sq. ft area boiler working at 50 lb per sq. in are 30 lb per hour for water or 250 lb per hour for benzene. The corresponding rates when using electric heating are 20 lb per hour and 110 lb per hour, respectively. *QVF Limited, Duke Street, Fenton, Stoke-on-Trent, Staffordshire.*



PRECISION GUILLOTINE

High Speed



THE series 25 range of guillotines is designed for high speed production methods.

The range includes models with capacities from 6 ft by ¼ in to 12 ft by ¼ in in mild steel. Speed of operation is up to 60 strokes per minute. It is claimed that a very clean cut is made owing to the fact that the slide moves downwards and backwards simultaneously. The bottom blade is mounted on a blade block which is adjustable over its full length to permit accurate setting of the blade clearance.

Power is supplied by an electric motor of high slip characteristics mounted coaxially with the worm shaft and flywheel. The drive is transmitted through a multi-jaw dog clutch which is released by a solenoid operated plunger controlled by a foot switch. Alternative control by push button or pendant can be supplied. On the standard machines the hold down is mechanically operated with each plunger separately spring loaded. A hydraulic system is also available as an alternative.

Two support arms are fitted to the front of the table and a squaring arm with two swing stops to suit the particular application can be provided. A precision back gauge with direct reading dial indicators can be fitted in place of the standard back gauge. This can be power operated by push buttons from the front of the machine with a dial indicator near the buttons to show the position of the gauge bar. Lighting is provided behind the guard and there is a chute for clearing blanks. *Rushworth and Company (Sowerby Bridge) Limited, Sowerby Bridge, Yorkshire.*

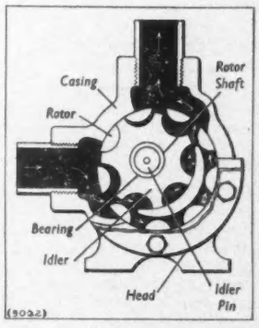
GEAR PUMP

Internal Teeth

A NEW range of internal toothed gear pumps will handle up to 250 gallons per minute at pressures up to 100 lb per sq. in.

These pumps are a development of the type used in petrol pumps and consist basically of two gear elements rotating within the body: the outer rotor being the driven member and the inner gear wheel being the idler. The latter meshes internally with the rotor and since it is eccentrically mounted it leaves space on the side opposite to the point of mesh for a crescent shaped member between the rotor and idler teeth.

The movement of the liquid is caused by the displacement of the pumping element (in this case the gear teeth) in the neighbourhood of the crescent to create a void into which liquid is forced by atmospheric pressure. The pump is thus self primining and can draw from below ground. The flow of liquid is continuous and approximately proportional to the speed of rotation.



The pumps can be supplied in all-iron, iron and bronze, or all-bronze and can therefore be used with a variety of liquids. They can also be supplied with steam jackets if required, and built-in relief valves between suction and delivery can be fitted. It is claimed that the rolling action reduces wear on the teeth while the close meshing gives high volumetric efficiency and quick priming. The ports can be sited for right or left hand operation. *Wayne Tank and Pump Company Limited, Western Road, Bracknell, Berkshire.*

OIL TIGHT CONNECTOR

For Thermocouples

AN oil tight connector has recently been produced particularly for thermocouple lead extensions.

Features claimed are compactness and cheapness in addition to being proof against the ingress of water or oil. The connector is suitable for the termination of thermocouples so that a quick and easy connection can be made to existing leadwires without disturbing long or complicated runs. Its use also eliminates the need for terminal strips and the risk of dirty connections.

The pins and sockets are made of thermocouple materials to prevent spurious e.m.f.'s being produced as the result of temperature gradients at the plug and socket. The pins are also made unlike to permit of one way connection only, ensuring correct phasing of the leads.

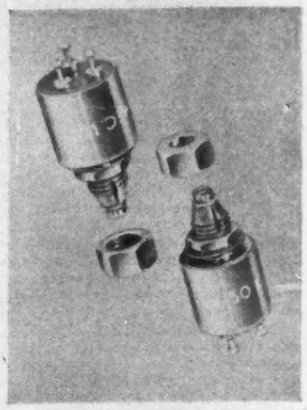
The housing of the connector is made of Monel and the overall dimensions are approximately ⅞ in diameter by 1½ in long.

The connecter is also suitable for the complete range of thermocouple types,

including mineral insulated thermocouples, in the metallurgical, nuclear and general engineering industries. They have given satisfactory operation in gas and steam turbine marine installations where their immunity to vibration and temperature changes shows to advantage. *West Instrument Limited, Regent Street, Brighton 1.*

MINIATURE POTENTIOMETER

Rotary Type



NOW in production is a miniature potentiometer capable of dissipating 1½ watts at 80° C.

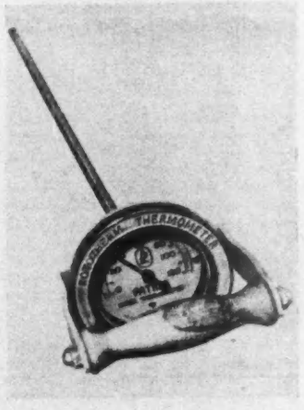
The TP5 is designed for trimming purposes and consists of a single turn. The maximum diameter is ½ in and the overall length is 1·14 in. The operating temperature range is from −55° to +150° C and it is fully sealed against climatic conditions. There are ten standard values being made in the range with resistances from 50 ohms to 50 kilohms. The resistance tolerance is ±10 per cent.

The potentiometers will withstand vibrations at 30*g* from 10 to 2,000 c/s. The load life is 2,000 hours and sustained accelerations up to 50*g* are permissible. The wire has a temperature coefficient of ±20 ppm per deg. C. Working voltage is 250V and proof voltage is 750V d.c. Minimum insulation resistance is 1,000 megohms at 500V d.c.

The base is made of corrosion resistant metal and has a locating pin. The spindle bushing is ¼ in by ¼ in unified fine thread which is split for locking. The element is wire-wound. Weight is less than 10 gm without the mounting nuts and the operating torque less than 6 oz-in. Minimum endstop torque is 3 lb-in and minimum terminal strength is ½ lb pull. *Miniature Electronic Components Limited, The Lye, St. John's, Woking, Surrey.*

THERMOMETER

For Stacked Material



DEVELOPED primarily for measuring the temperature of stacks of paper, the Patra thermometer can be used for checking most interior temperatures.

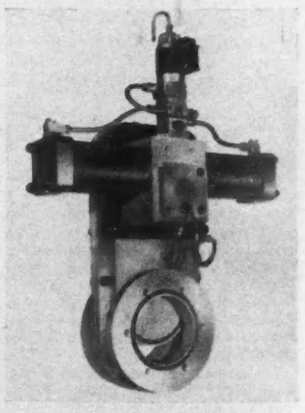
The instrument has a stem 15 in long at the end of which is the measuring element. This consists of a bimetallic multiple helix which expands with increase of temperature and transmits the movement to the pointer on the dial. The design is such that the actual sensitive area is very small and the thermal capacity of the whole kept low. As a result, spot temperatures can be quickly ascertained. The tip is spade shaped to allow it to be slipped between layers. About 15 minutes is required for a steady temperature to be attained.

The spindle is fully floating and retains its position relative to the dial without bearings. The dial is mounted on a solid metal diecast body and is covered with heavy plate glass. The whole is made robust for protection against mechanical shocks and is fitted with a stout wooden handle.

An accuracy within 1 per cent of full scale can be obtained over the range, which in the standard instrument is from 0 to 120° F. The thermometer is weatherproof and weighs 1½ lb. *British Rototherm Company Limited, Merton Abbey, London, SW19.*

HIGH VACUUM VALVE

Free Flow



AN unobstructed opening is one of the claims for a new range of Camvac high vacuum valves.

The range is being made in four sizes with bores of 1 in, 2 in, 4 in, and 6 in, and with either pneumatic or hand operation.

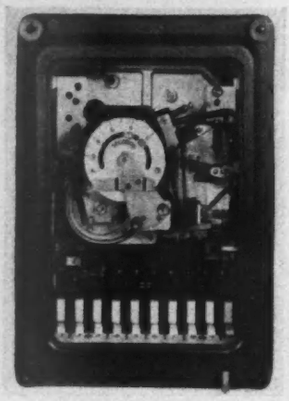
It is claimed that the construction of the valves is unique as the operating mechanism keeps the valve-disc O-ring gasket clear of contact with the valve body until the cutoff action occurs. When the valve is closed the total leakage at a pressure of 10^{-9} mm of mercury is less than 10^{-10} atm. c.c. per sec across the valve disc either way against atmospheric pressure.

The valve body and the sealing disc are made of dense 2 per cent silicon aluminium alloy with hard coated slideways. A stainless steel valve stem and screw thread inserts of the same material are included in the construction of standard models.

The illustration shows a 4 in bore valve, type VG4T2, fitted with a power actuator. The latter is arranged for remote electric control and will produce a torque of 25 lb-ft for an airline pressure of 60 lb per sq. in. The valve flanges have standard drillings for connecting into pipelines. *Vacuum Research (Cambridge) Limited, Quayside, Bridge Street Cambridge.*

EARTH FAULT RELAY

Time Delay



RECENTLY introduced, the CMU is a sensitive polarised relay for earth fault protection.

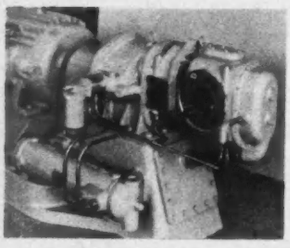
The instrument is designed to operate at very low earth fault currents and incorporates an adjustable time delay to ensure that the circuit breaker is not tripped until the main earth fault protection has had time to disconnect the faulty section. The relay is protected against high fault currents by a saturable current transformer.

The measuring element is a sensitive polarised relay supplied with rectified current, derived from the main current transformers. The minimum setting is for 0·1 A. Hand and self resetting versions are available. The burden is only 0·005 VA at pickup, so the effective primary setting is almost equal to the actual relay setting. Maximum thermal rating is for 200 A for 2½ sec. The timer gives delays from 2 to 10 sec on pickup with instantaneous drop off.

The unit is contained in a single pole draw-out case. Indication of operation is by a flag on the timer in the self reset type, and by a flag on an auxiliary unit which is operated by the timer in the hand reset version. The auxiliary unit contacts are arranged for blocking auto-reclose circuits. *English Electric Company Limited, Marconi House, Strand, London, WC2.*

SCREW COMPRESSOR

30 lb per sq. in Delivery



A SERIES of screw type air compressors is now being made in this country under licence. Details of the construction are given on p. 739 under Design.

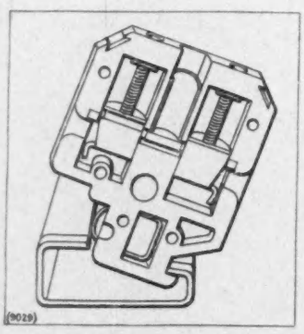
These are positive displacement machines giving a pressure ratio of 2 to 1 and therefore capable of working at higher pressures than a single stage Root's machine. The model illustrated is the type 220 which has a delivery of 450 cu. ft per minute at 30 lb per sq. in for an input horse power of 60. The delivered air is free from oil.

The two rotors are unlike, the male having four lobes and the female having six gullies. This arrangement gives the two equal strengths in bending. The drive is to the male and the female is linked to it by timing gears. There is no contact between the rotors, or between the rotors and the casing. Air enters the inlet port and fills the space between one lobe and gulley as it is exposed. Continued rotation "unwraps" the screws and exposes more entry space until the port is cut off by the arrival of the next lobe and gulley. The trapped air is then carried round the circumference until the lobes and gullies again mesh when it is compressed to the outlet port. The position of the outlet port thus determines the pressure ratio obtainable in the machine.

The outputs quoted are for a speed of approximately 18,000 r.p.m. normally obtained by a step-up gearing from an electric motor. The bearings are pressure lubricated with seals to prevent any oil entering the air space. The temperature of the air at outlet is 200° C. *Sir George Godfrey and Partners Limited, Hampton Road West, Hanworth, Middlesex.*

TERMINAL BLOCK

Clip-In Construction



TERMINAL blocks are available that clip into a mounting rail making up complete assemblies.

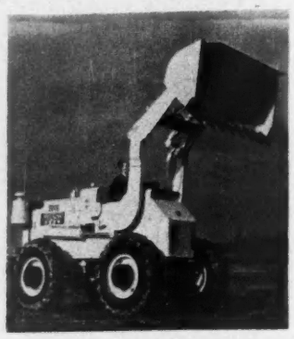
The blocks are being made in several sizes for continuous current ratings of 25, 40, 60, 80, and 100 A. The terminal body is made of melamine plastic which has very good electrical characteristics. The metal mounting rail is made in 6 ft lengths and can be fixed either vertically or horizontally direct to framework or back plate using countersunk screws. Alternatively it can be mounted on angled fixing brackets.

The blocks hook under the lower edge of the rail and are held under the higher edge by a spring clip that is compressed during insertion. The slip is captive in the body. Where the assembly is likely to encounter severe vibration a locking pin can be inserted along the blocks behind the sping clip so that the latter cannot be compressed by accident. End clamps and covers are available to complete assemblies.

A solid contact bar, grooved to give improved contact, extends across both leads and is held against them by two screws. To allow for parallel circuits, a paralleling strip is made in 25 pole lengths and there are breakout sections in the blocks to allow for its insertion. An earthing clip with terminal fits on the rail and there are warning and identity labels of white card with coloured transparent covers. *Oberterm Electrical Company Limited, 80 New Bond Street, London, W1.*

TRACTOR SHOVEL

2¼ cu. yd Bucket



THE Nelson four wheel drive tractor shovels are now available in this country.

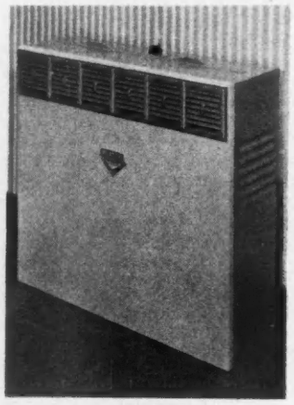
The model illustrated is the 200D, powered by a 105 h.p. diesel engine. It has a 2¼ cu. yd bucket with a rated lifting capacity of 13,000 lb. The bucket has a 40° crowd angle and a discharge angle at maximum height of 50°. Maximum clear discharge height is 9 ft 6 in with a forward reach of 2 ft 2 in.

Power is transmitted to the axles by an Allison Torqmatic drive consisting of a torque converter, planetary transmission and transfer gears. All clutches are hydraulically operated. There are three forward and three reverse speeds from 3·5 to 27 m.p.h. There is also a rear axle disconnect for road travel. On the axles are hypoid differentials with planetary final drives in the wheel hubs. Steering is power assisted. Working brakes on all four wheels are hydraulically operated and vacuum boosted; a mechanical brake operates on the forward transmission shaft.

Hydraulic power is provided by a gear pump driven from the transmission, with an output of 48 g.p.m. The control valve is the two spool type with built-in adjustable relief valve. All rams are double acting. Special claims are made for the accessibility and operator comfort. The cab has all round visibility and the controls are conveniently grouped to avoid fatigue. *Merton Engineering Company Limited, Faggs Road, Feltham, Middlesex.*

AIR CONDITIONER

Floor Mounting



A PACKAGED unit for room air conditioning is the latest addition to the Temkon range.

The Whispair is claimed to be very quiet in operation and to cost about half the price of a central station of the same capacity. Another advantage is that it allows the occupants of the room to adjust the conditions to their own choice. It is a self contained unit measuring 30 in high, 33 in wide, and 10 in deep, thus having a slimline style. Twin circulating fans and efficient sound insulation account for the silent operation.

Simplicity of control and ease of maintenance are two features claimed. A single thermostat controls the room temperature and the entire front panel can be unclipped.

Four-way adjustable grilles in the front give even distribution and the unit is fitted with a 2 kW heater, also thermostatically controlled. The hermetically sealed refrigeration unit has a nominal capacity of 1 ton (12,000 Btu per hour) at maximum tropical conditions. A nylon filter is included to remove dust particles which can be lifted out of the top for cleaning. Airflow in the indoor coil is 360 cu. ft per min and humidity removal is 5 pints per hour maximum. Air or water cooled models are available. *Temperature Limited, Burlington Road, London, SW6.*

ROUGHNESS TESTER

All Types

AN improved version of the Diavite Microtester for surface finish incorporates push button selection for measuring centre line average; maximum height of profile from mean centre line; and maximum depth of scratches, peak to valley.

The ability to determine the last named is of special value when ascertaining the surface damage of a work piece. For example in transistor manufacture, if the depth of damage is known, the amount of etching to remove it can be predicted thereby reducing times in the production process.

The instrument covers the range from 0 to 300 micro-inches with three available "cut-off" lengths (waviness limited) of 0·003 in, 0·010 in and 0·030 in. The roughness reading of all the three different types is shown on the meter.

Various types of tracer head are available for measuring flat surfaces, bores, tooth flanks, ball races, etc. The standard instrument is fitted with a stylus head having a stroke length of 4 mm. A special model can be supplied providing three alternative stroke lengths between 1 and 2 mm. A pen recorder for making permanent records of the surface measured is also obtainable for fitting to the tester. *Payne Products International Limited, Lawrence Estate, Green Lane, Hounslow, Middlesex.*

Esoteric Art of Tendering

Finesse in tendering is essential when competing for the supply of entire factories under package deal contracts. The experience of nuclear firms in this context can be applied to other fields of engineering with advantage.

By B. G. Bodroghy, D.I.C., B.A.Sc.

A POST-WAR phenomenon in engineering contracts is the emergence of the "package deal," in which a single contractor or consortium of contractors is selected to supply and erect an entire plant, complete to the last coathanger and light bulb. Package deals give the purchaser two important advantages: only a single contract has to be negotiated; and the onus of coordination between a multitude of subcontractors falls on the supplier without the purchaser relinquishing control over the design, fabrication or erection of the plant.

Package deals are especially suitable where the plant involved is designed for a specialised or novel process, and is to be erected in a country where the home industry is not in a position to supply the greater part of the components. Russia and India have been important customers of British industry in the past, with package deals for steel mills and tyre factories. More such contracts can be expected as underdeveloped countries attempt to catch up with the rest of the world by buying the most modern manufacturing facilities available without waiting for the local supply industry to grow up.

From the importer's point of view a further advantage of the package deal is that a firm price for the entire plant is obtained from the tenders before the purchaser has committed himself to buy. In normal contracting the final cost emerges only as equipment and components are bought, and may exceed the original estimates by a wide margin. The firm price quoted in a tender for a package deal enables the purchaser—often a government—to budget accordingly or to withdraw (depending on whether the price is suitable) without having spent a single penny. For this reason alone the package deal's popularity should increase in the future.

FINESSE

It has become the habit to call for world-wide tenders in connection with these important contracts, so that competition is keen and finesse in tendering becomes important. The greatest experience in the art of tendering for package deals has been accumulated by the United Kingdom nuclear groups, who tender on the average for two contracts a year.

The conditions of tendering for nuclear and manufacturing plant package contracts are very similar. In both cases the tendering firms tend to be "consortia" rather than individual firms, where a consortium can be defined as an association of complementary firms for the purpose of tendering for a package deal. Short of poaching on their commercial officers, the best way to learn from the nuclear consortia is to study their methods of tendering.

THREE AIMS

Tenders are multipurpose documents with the ostensible aim of describing and defining the plant offered to the customer. But going far beyond mere description, the true aim of a tender is to sell the product in the face of keen competition.

A further important purpose of the tender document is contained in the quotable paradox of contracting that the customer never buys the plant proffered: the tender is only a concrete basis for subsequent negotiations.

The three purposes—definition, selling, and basis for negotiation—circumscribe the amount of engineering detail that has to be incorporated in the document. The early export tenders for nuclear plant were mainly descriptive, and their make-up was based on the assumption that the customer would not possess the necessary technical knowledge to appreciate the finer points of engineering incorporated in the design.

Today it must be assumed that the customer has technical knowledge and skill equal to that of the bidder unless there is good reason to believe that the process involved in the contract is a recent development, knowledge of which is confined to a very few.

If full knowledge is assumed on the side of the purchaser, it is desirable to disclose every conceivable detail of the design in order to convince the customer of the supplier's competence and engineering skill. But if knowledge of the process is believed to be confined to a small circle from which the customer himself is excluded, then the tender must become a masterpiece of concealment. The aim then is to dazzle the customer with the supplier's skill without disclosing any of the information that forms the basis of the firm's technical superiority. Commercial security becomes the cardinal consideration: if full details are given in the tender, a customer may decide to build the plant himself, or commercial security may be broken through an accident.

A recent, although not very serious, breach of commercial security occurred in connection with a major project of a large public body. Owing to a clerical error, the reviewing authority's criticisms of two tenders were mailed to the wrong addresses. It is believed that in the short time that the rival firm's documents remained in their possession, the consortia learned more from the other firm's mistakes than they ever did from their own. Such accidents can, and do happen even with customers of the highest integrity, and the tendering firm must decide how much of its technical secrets it can afford to risk.

Where concealment is important, a neat method of avoiding disclosure of too much information is to point to previous contracts as proof of competence—where available. Nothing will generate more confidence than demonstration of a working prototype, a technique the American nuclear firms have used to advantage on many occasions.

SALESMANSHIP

A tender must attempt to sell to several levels of management in the purchaser's organisation, with technical knowledge varying from dilettantism to expertise. Appropriate sections of the tender are toned and aimed accordingly.

The *Covering Letter*, forming the first pages of the document, is directed at the highest levels of management. The letter's aim is to assure the customer that the tendering firm is competent and qualified to carry out its tasks by referring to the size, experience and staff of the organisation. Regarding the proposed plant, the covering letter need only stress certain important, but to the layman intelligible, features such as an unusually high product recovery, or efficient utilisation of materials and energy. It is good practice to include at this stage any reservations or deviations from the inquiry specifications, and the guarantee.

Progressing down the ladder of management, the next line of resistance to be breached is at the chief engineer level. The section devoted to this purpose is called the *Description*, in which the outstanding engineering features of the plant and its components are stressed section by section. It is aimed at a reader who is an engineer, but who may be a specialist in only a single aspect of the design, or someone who has ceased to be a specialist in anything except administration. The Description is therefore technical and carefully reasoned, but without being scientific or using mathematics as a mode of communication. It is preferable to supply the Description in a separate volume from other sections of the tender to permit weekend reading.

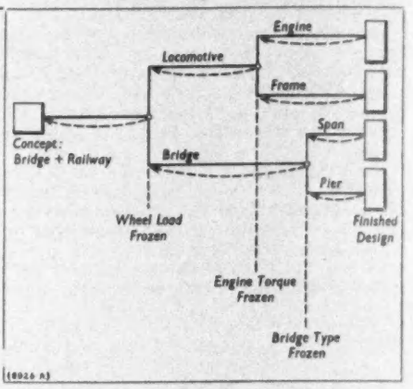


Fig. 1 Seldom is there time to optimise a complete design; usually the design must be frozen in stages.

Expert panels will evaluate the detail design in a tender of any complexity and the bulk of a tender, sometimes called the *Programme*, is written for the use of these panels. It is the costliest part to prepare and shows the greatest variation when presented to customers with different technical knowledge or integrity.

COMPLETENESS AND COMPARISON

In layout the Programme must follow closely the order of presentation and section numbering adopted in the customer's inquiry specification in order to facilitate checking for completeness and comparison with competing tenders. It is written by specialists for specialists, and makes full use of mathematical language. As the various panels will be studied simultaneously, it is again desirable to have different sections bound in separate volumes.

"Soft sell" is an advertising term referring to a subtle technique in which a customer's sales resistance is overcome by indirect means. A spectacular bit of "soft sell" is used by the nuclear consortia in the form of scientific reports—called *Supporting Reports*—appended to the tender. The reports are prepared by the company's research staff and may take up as much space as the rest of the tender. Some are essential to the full understanding of certain features of the proposed plant, but quite often a report is simply included to emphasise the scope and success of the bidder's research efforts in order to add prestige to the tender. The supporting reports form the most technical final link of the tender, completing a logical series that started with the non-technical covering letter.

Receipt of the customer's inquiry specification and delivery of the finished tender define the tendering period. The hectic time between these dates may last anywhere up to 18 months and may see the expenditure of a quarter of a million pounds in wages, reproduction charges, licence fees and computer rental. If the deadline for the delivery of the tender is missed by as much as an hour, the chances of success suddenly become nil and the investment is automatically lost. To avoid such a calamity, the tendering period must be carefully planned, starting with presentation and working backwards.

PRIVATE PRINTING PLANT

Since so much is at stake, a firm cannot afford to risk a last-minute delay through a printer's strike or a breakdown in the equipment or communication. Hence a privately owned printing plant located near the design office is considered essential to successful tendering. The plant must be capable of printing about 600 pages per day—a hundred sheets of each

page—during the peak period, and will thus be inefficiently utilised during the rest of the time. But possession of a printing plant permits last-minute changes to be made in design, allows for the inevitable delays in copy preparation by working unscheduled overtime, and improves the commercial security of the organisation.

Knowing the peak capacity of the printing plant, the allowance for printing and binding can be subtracted from the available preparation time. Key dates for freezing certain aspects of the design must then be selected.

Design is an inherently reiterative process. It is impossible to design a bridge until its self-

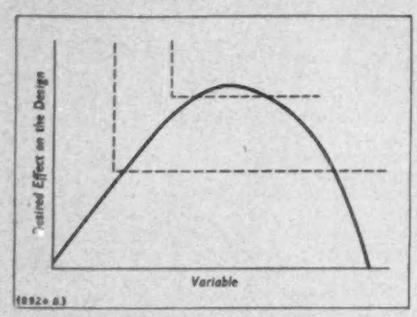


Fig. 2 Any optimisation curve can be made to appear flat by selecting suitable scales; the trick is to reach that scale in a few reiterations.

weight is known; hence to make a start the weight must be assumed and the assumption checked and corrected. But a factory or power plant is far more complicated, and its design requires an elaborate process of optimisation if it is to be competitive. The example of the bridge can be extended slightly to illustrate the point.

Supposing the task is to tender for a complete transportation system involving a bridge and the trains passing over it. The *concept* is thus a locomotive, giving a system of moving loads passing over a bridge. In order to permit completion of the necessary reiterations on the bridge within a specified time, the locomotive wheel-loads must be "frozen" well before the locomotive is fully optimised. Further optimisation of the locomotive's details is possible only provided the wheel-loading remains unchanged. The selection of "frozen" dates for wheel loading, traction, and bridge type are illustrated arbitrarily in Fig. 1.

OPTIMISATION AND FROZEN DATES

There is always a chance that the design will not be completely optimised as a result of using frozen dates, but with a little experience the loss need only be small. Every point of divergence in a design introduces new elements of optimisation. Short of working out a computer code to encompass every variable, it is quite impossible to test the effect of small changes in every variable on the performance of the whole plant.

Fortunately any performance curve can be made to look flat as illustrated in Fig. 2 by selecting suitable scales. Experience should enable the designer to select by guesswork a point within the middle set of coordinates shown in the figure, and a very few reiterations should bring the design into the top set. From then on it does not really matter whether the design point is at the curve's maximum or not, the effect on overall performance will be slight. Thus practice in the preparation of tenders is essential to success: the time limitation does not permit corrections.

For any plant involving heavy concentrated loads the freezing of these loads is one of the most important key dates. Where the Inquiry Specification demands the submission of detailed bills of quantities, the freezing of the entire civil engineering design becomes another important date. The dates by which subcontractors' tenders for certain plant components must be received can then be selected to fit in with the schedule. As subcontracted items usually involve standard products, the time allowed for tender preparation need only be 6 weeks. For non-standard items about 10 weeks have to be allowed. But some consortia, with accumulated experience in tendering for similar plant, avoid the expense of calling for subcontractors' tenders and base their design on previous experience. Both time and money are saved, and the probability that the estimates may be wrong is small.

Fig. 3 illustrates the tendering period for a typical large firm. It is assumed that the firm's research effort is carried on continuously, but its effect on the current tender is cut off gradually as the various frozen dates are reached. For simplicity's sake it is also assumed that supporting reports are only prepared when direct support of the tender is completed, although under normal conditions a number of these will have peen completed a long time before tendering starts.

EDITORIAL PRACTICE

To avoid congestion at any level of tender preparation it is essential to ensure a continuous flow of copy through a well-spread period of time. The most obvious bottlenecks are editing and printing, the one limited by the capacity of a few men to read with attention a large amount of writing, the other by the availability of machines.

From the point of view of presentation it would be desirable to have the whole tender edited—if not written—by a single person. But since a tender may consist of 6,000 pages of foolscap, and preparation time is limited the number of authors may reach a hundred and editing is done by a panel. To ensure uniformity of presentation and style, a manual of editorial practice is prepared in advance and its rules enforced. The manual is circulated to all authors, who must refer to it for guidance in style, the use of abbreviations, titling, pagination and the use of paragraphs.

Essential qualifications of an editor are (besides an appreciation of good technical writing) a disinterestedness in the passing of manuscripts and an appreciation of the technical problems involved. Disinterestedness rules out the department heads from editing the sections prepared by their own staff, although they must still be responsible for technical accuracy, consistency and compatibility with other sections of the tender.

As the editorial staff will be preparing dozens of sections simultaneously, with frequent cross references to sections and drawings still under preparation, a simple system of pagination becomes impossible. A detailed index has to be prepared in advance that will list in logical sequence each section, subsection, sub-subsection, drawing and graph that will be incorporated in the tender. A consistent system of paragraph numbering is then employed to permit advanced cross-referencing. The *Index* and *Drawing Index* are the first documents prepared in connection with the tender, and previous experience in tendering becomes invaluable in ensuring completeness. It is convenient to assign fully in the Index the department, the author, and the editor responsible for each sub-subsection, the estimated number of pages required and the date of completion for each phase of the work. The Index thus becomes a master document used for the estimating of manpower, overtime, and the cost of tender preparation.

PRICING AND ANALYSIS

Concurrently with the preparation of the tender's descriptive and scientific sections, work directed at estimating the bid-price must be in progress. If the customer has very definite ideas of what components he will want incorporated in the plant, the basic document for pricing will be supplied with the inquiry in the form of an inventory called *Schedules*. But whether an inventory is provided by the customer or not, the bidder prepares a much more detailed *Schedule Index* for his own use listing every nut and bolt that will be supplied with the plant. A rational system of part numbering is used to correspond to sections of the Description and the Inquiry Specification.

The supply engineer of each section of the contract department is responsible for filling in the prices of plant components. The process of estimating is then begun, which is similar to that used in any other contract work, complicated only by the complexity of the plant.

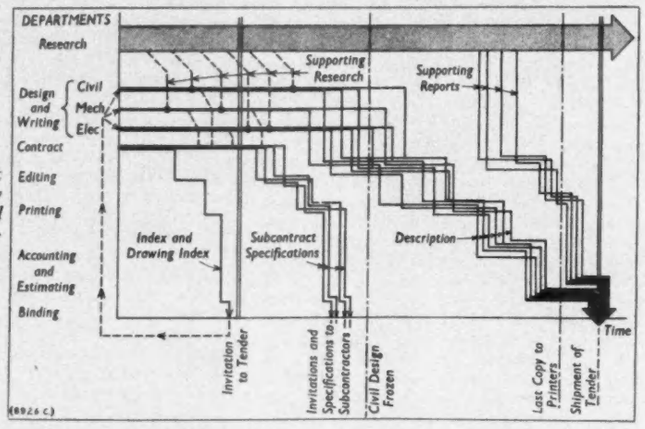


Fig. 3 A close check must be kept on the flow of documents to avoid congestion at the inevitable bottlenecks.

From the *Estimate Makeup*, a *Summary* and an *Analysis* are produced, the former for presentation for the approval of the board of directors, the latter for checking any discrepancies in the tender. Significant deviations in the cost of various sections from previous contracts are tracked down to see if the cause is an error or a change in the design.

CHASING COPY

Keeping to schedule is the most critical problem in the preparation of a tender. The available time is always too short and engineers are never quite satisfied with their work as incorporated in the tender. But since so much is at stake, and some post-tender changes in the design are almost inevitable, a great deal of ruthlessness is essential in enforcing the tendering schedule.

The contract department uses a team of "copy chasers" who, equipped with a card index file for every sub-subsection of the tender, follow the movement of copy from author to typist to editor; back to the author and on through the various stages of printing and correcting to the point where the tender is bound and shipped. Coloured riders on the index cards indicate the amount of copy resting with any one department. A dense cloud of riders will show that in spite of precautions there is congestion. If the congestion occurs before one of the traditional bottlenecks, appropriate steps can be taken to increase the staff or allot more overtime, for the tender must leave the office on schedule or else the effort is lost.

Mass Spectrometry

Isotopic analysis of uranium and other elements has to be carried out with great accuracy, since precise measurement of composition, as in determining enrichment factor, is of profound economic importance.

Determining Isotopic Composition

Several techniques are available for determining the isotopic composition of uranium including optical spectrometry; gamma spectrometry; mass spectrometry; fission counting; neutron activation; neutron absorption and zero power reactors. Although these methods offer individual advantages, they have one common disadvantage—that of requiring specialised and expensive equipment. Of all the approaches listed, the mass spectrometer has proved to be most valuable because of its accuracy. It is the only instrument available that will analyse uranium over the full range of isotopic compositions, from depleted to fully enriched in the uranium 235 isotope, to within 0·10 per cent. *Mass Spectrometry for Uranium Isotope Measurements*, by C. D. Tabor, has been published by the International Atomic Energy Agency and reviews developments in this field.

Analysis by Spectrometer

In the mass spectrometer, ions are formed by bombarding gaseous molecules with electrons or by thermal evaporation of ions from solid samples deposited on the filament in the ion source. The ions are accelerated by permitting them to traverse an electrostatic field over a range from several hundreds to several thousands of volts, depending on the design of the instrument. Next the ions are separated in a magnetic field where they traverse circular paths having radii proportional to the mass-to-charge ratio. Analysis is accomplished by placing collector targets in suitable positions to intercept the separated ion beams, thereby producing electrical charges on the targets. The charges create small electrical currents which are amplified and recorded.

Two Basic Forms

Mass spectrometers used for uranium isotopic abundance measurements are based on two concepts:

(1) Instruments using an electron bombardment ion source; these are most suitable for the analysis of gaseous samples.

(2) Instruments using a thermal ion source, which are more applicable for solid sample analysis, and for very small samples.

The second method is used when the samples are more readily convertible to a uranium oxide than to the hexafluoride, and particularly in analyses involving the use of isotopic dilution techniques.

Focusing and Ion Velocity

A further division is also possible into single or double focusing, but for the analysis of uranium the former is usually satisfactory. Since the spectrometers using first order directional focusing are sensitive to ion momentum rather than to ion mass, the ions introduced into the mass analyser must be essentially monoenergetic for the analyser to differentiate between those of different mass. Thus the ion source must be designed to produce and accelerate monoenergetic ions. The angle of deflection may be any value up to 180°. The choice involves a compromise between the longer ion trajectory for small angles and the heavier magnets required for the large deflection angles. Fig. 1 shows an instrument with a deflection of 60°: in the case of the 180° instrument the radius of curvature will include a complete semicircle.

Performance Characteristics

Two main factors govern the performance of the spectrometer; the sensitivity and the resolution:

(1) The sensitivity is affected by the efficiency of the ion formation process and the ion optics in the source. Thus the sensitivity may be influenced by the size of the collimating slits and the magnetic field refocusing properties.

(2) Resolution is the ability to separate ions of adjacent masses and is affected by the degree of collimation achieved in the source, the refocusing action of the magnetic source, and the instrument geometry.

Essential Components

Mass spectrometers to be used for isotopic abundance measurements must include the following: (1) a suitable introduction system into the ion source; (2) an ion source able to produce a steady and adequate source of approximately monoenergetic ions and to accelerate these ions into the magnetic field; (3) a magnetic-field mass analyser with a performance stability consistent with the resolution requirements; and (4) an ion detection system for the electron bombardment instrument to measure ion currents of approximately 10^{-11} A to within 0·01 per cent.

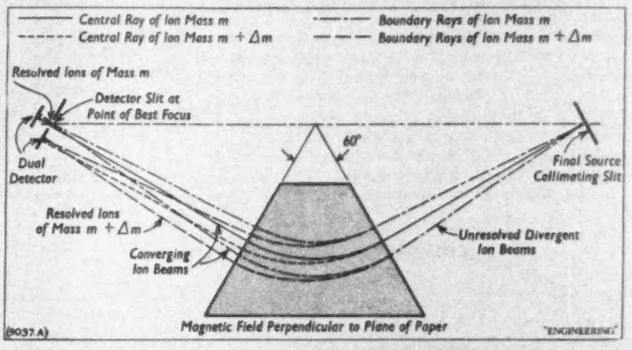

Central Ray of Ion Mass m
Central Ray of Ion Mass m + Δm
Boundary Rays of Ion Mass m
Boundary Rays of Ion Mass m + Δm
Resolved Ions of Mass m
Detector Slit at Point of Best Focus
Dual Detector
60°
Final Source Collimating Slit
Resolved Ions of Mass m + Δm
Converging Ion Beams
Unresolved Divergent Ion Beams
Magnetic Field Perpendicular to Plane of Paper
9037.A
"ENGINEERING"

Fig. 1 (right) Analysing instrument using a 60° deflection angle.

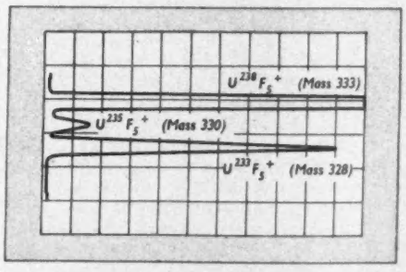


Fig. 2 Scanning of isotopic ion peaks. In the uranium hexafluoride gas samples, the positively charged UF_6^+ ions are the most predominant.

Preparation for Analysis

It is often necessary to alter the uranium into a form suitable for the instrument into which it is to be introduced. Several methods are possible for the conversion to uranium hexafluoride, which is used in electron bombardment instruments, as indicated in the USAEC report prepared by Goodyear Atomic Corporation, *Works Laboratory Instruments*, GAT-115/Rev.1 (1957), Vol. 1. Similarly for the thermal ion source instruments, some preliminary treatment may be required before insertion into the instrument. The United States National Bureau of Standards has established a set of uranium isotope standards and this has necessitated very careful analyses at varying concentrations of the uranium 235 isotope. Hexafluoride blending and oxide blending are two methods used to prepare standard materials at other concentrations if two sets of base materials of widely different isotopic concentrations are available.

Memory Effect

A disadvantage of the electron bombardment method is that the uranium hexafluoride reacts with the exposed surfaces. This produces a memory effect with the result that the analysis of a particular sample tends to be biased in the direction of the isotope composition of the last sample, which can greatly affect and limit the precision of the instrument. Development has progressed in reducing the memory effect by the suitable preparation of the uranium hexafluoride; it is also necessary to produce a very pure sample. The thermal emission ion source mass spectrometer is not as susceptible to the memory problem and it is possible to pay more attention to the analytical procedures of sensitivity and accuracy.

Peak Recording

The comparison with standards is more generally used with the electron bombardment instrument. Fig. 2 shows the scan of isotope peaks. Prior to the recording of the peaks the total ion current for several uranium isotopes is adjusted to a suitable required intensity and allowed to stabilise. The recording of the peaks is achieved by sweeping the accelerating voltage or magnetic field current in a way to obtain a scale of the ion beams.

Notes and News

New Cobalt 60 Price Schedule

The United States Atomic Energy Commission has revised its prices for cobalt 60 and established a new schedule of discounts for large quantity purchases. The aim is to encourage the use of ionising radiations as a major industrial and biological tool. A charge of $1 per curie for all material in quantities greater than 100,000 curies has been set, and in this case no regard is paid to the specific activity The charges do not include source selection, handling or shipping charges.

Specific Activity (curies per gram)	*List price per Curie*
1 to 25	$2·00
26 to 40	3·00
40 to 55*	4·00

Discounts

0 to 5,000 curies	List price
5,001 to 25,000 curies	List price less 25 per cent
25,001 to 100,000 curies	List price less 50 per cent
greater than 100,000 curies	All material for $1·00 per curie

* Specific activities greater than 55 curies per gram are out of the normal production range.

End of the Road for NTP

Design work on the Nuclear Test Plant which was to be built in the USAEC's Army Reactor Experimental Area near Idaho Falls has ended. The decision was based on changes in the programme for the military requirements of field nuclear power plants. The NTP was to have used a water-cooled reactor system having good flexibility and extensive instrumentation to facilitate the full-scale testing of prototype

page—during the peak period, and will thus be inefficiently utilised during the rest of the time. But possession of a printing plant permits last-minute changes to be made in design, allows for the inevitable delays in copy preparation by working unscheduled overtime, and improves the commercial security of the organisation.

Knowing the peak capacity of the printing plant, the allowance for printing and binding can be subtracted from the available preparation time. Key dates for freezing certain aspects of the design must then be selected.

Design is an inherently reiterative process. It is impossible to design a bridge until its self-

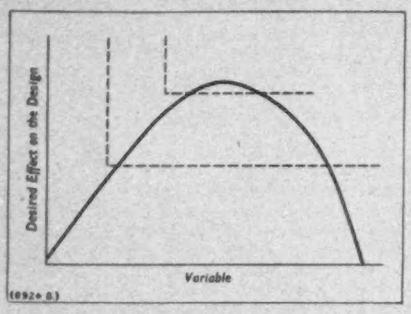


Fig. 2 Any optimisation curve can be made to appear flat by selecting suitable scales; the trick is to reach that scale in a few reiterations.

weight is known; hence to make a start the weight must be assumed and the assumption checked and corrected. But a factory or power plant is far more complicated, and its design requires an elaborate process of optimisation if it is to be competitive. The example of the bridge can be extended slightly to illustrate the point.

Supposing the task is to tender for a complete transportation system involving a bridge and the trains passing over it. The *concept* is thus a locomotive, giving a system of moving loads passing over a bridge. In order to permit completion of the necessary reiterations on the bridge within a specified time, the locomotive wheel-loads must be "frozen" well before the locomotive is fully optimised. Further optimisation of the locomotive's details is possible only provided the wheel-loading remains unchanged. The selection of "frozen" dates for wheel loading, traction, and bridge type are illustrated arbitrarily in Fig. 1.

OPTIMISATION AND FROZEN DATES

There is always a chance that the design will not be completely optimised as a result of using frozen dates, but with a little experience the loss need only be small. Every point of divergence in a design introduces new elements of optimisation. Short of working out a computer code to encompass every variable, it is quite impossible to test the effect of small changes in every variable on the performance of the whole plant.

Fortunately any performance curve can be made to look flat as illustrated in Fig. 2 by selecting suitable scales. Experience should enable the designer to select by guesswork a point within the middle set of coordinates shown in the figure, and a very few reiterations should bring the design into the top set. From then on it does not really matter whether the design point is at the curve's maximum or not, the effect on overall performance will be slight. Thus practice in the preparation of tenders is essential to success: the time limitation does not permit corrections.

For any plant involving heavy concentrated loads the freezing of these loads is one of the most important key dates. Where the Inquiry Specification demands the submission of detailed bills of quantities, the freezing of the entire civil engineering design becomes another important date. The dates by which subcontractors' tenders for certain plant components must be received can then be selected to fit in with the schedule. As subcontracted items usually involve standard products, the time allowed for tender preparation need only be 6 weeks. For non-standard items about 10 weeks have to be allowed. But some consortia, with accumulated experience in tendering for similar plant, avoid the expense of calling for subcontractors' tenders and base their design on previous experience. Both time and money are saved, and the probability that the estimates may be wrong is small.

Fig. 3 illustrates the tendering period for a typical large firm. It is assumed that the firm's research effort is carried on continuously, but its effect on the current tender is cut off gradually as the various frozen dates are reached. For simplicity's sake it is also assumed that supporting reports are only prepared when direct support of the tender is completed, although under normal conditions a number of these will have peen completed a long time before tendering starts.

EDITORIAL PRACTICE

To avoid congestion at any level of tender preparation it is essential to ensure a continuous flow of copy through a well-spread period of time. The most obvious bottlenecks are editing and printing, the one limited by the capacity of a few men to read with attention a large amount of writing, the other by the availability of machines.

From the point of view of presentation it would be desirable to have the whole tender edited—if not written—by a single person. But since a tender may consist of 6,000 pages of foolscap, and preparation time is limited the number of authors may reach a hundred and editing is done by a panel. To ensure uniformity of presentation and style, a manual of editorial practice is prepared in advance and its rules enforced. The manual is circulated to all authors, who must refer to it for guidance in style, the use of abbreviations, titling, pagination and the use of paragraphs.

Essential qualifications of an editor are (besides an appreciation of good technical writing) a disinterestedness in the passing of manuscripts and an appreciation of the technical problems involved. Disinterestedness rules out the department heads from editing the sections prepared by their own staff, although they must still be responsible for technical accuracy, consistency and compatibility with other sections of the tender.

As the editorial staff will be preparing dozens of sections simultaneously, with frequent cross references to sections and drawings still under preparation, a simple system of pagination becomes impossible. A detailed index has to be prepared in advance that will list in logical sequence each section, subsection, sub-subsection, drawing and graph that will be incorporated in the tender. A consistent system of paragraph numbering is then employed to permit advanced cross-referencing. The *Index* and *Drawing Index* are the first documents prepared in connection with the tender, and previous experience in tendering becomes invaluable in ensuring completeness. It is convenient to assign fully in the Index the department, the author, and the editor responsible for each sub-subsection, the estimated number of pages required and the date of completion for each phase of the work. The Index thus becomes a master document used for the estimating of manpower, overtime, and the cost of tender preparation.

PRICING AND ANALYSIS

Concurrently with the preparation of the tender's descriptive and scientific sections, work directed at estimating the bid-price must be in progress. If the customer has very definite ideas of what components he will want incorporated in the plant, the basic document for pricing will be supplied with the inquiry in the form of an inventory called *Schedules*. But whether an inventory is provided by the customer or not, the bidder prepares a much more detailed *Schedule Index* for his own use listing every nut and bolt that will be supplied with the plant. A rational system of part numbering is used to correspond to sections of the Description and the Inquiry Specification.

The supply engineer of each section of the contract department is responsible for filling in the prices of plant components. The process of estimating is then begun, which is similar to that used in any other contract work, complicated only by the complexity of the plant.

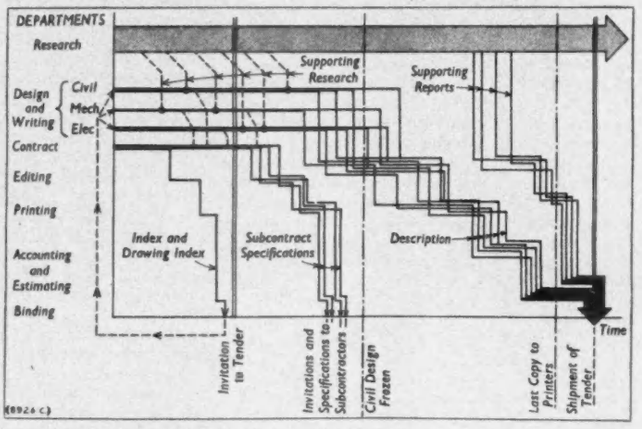


Fig. 3 A close check must be kept on the flow of documents to avoid congestion at the inevitable bottlenecks.

From the *Estimate Makeup*, a *Summary* and an *Analysis* are produced, the former for presentation for the approval of the board of directors, the latter for checking any discrepancies in the tender. Significant deviations in the cost of various sections from previous contracts are tracked down to see if the cause is an error or a change in the design.

CHASING COPY

Keeping to schedule is the most critical problem in the preparation of a tender. The available time is always too short and engineers are never quite satisfied with their work as incorporated in the tender. But since so much is at stake, and some post-tender changes in the design are almost inevitable, a great deal of ruthlessness is essential in enforcing the tendering schedule.

The contract department uses a team of "copy chasers" who, equipped with a card index file for every sub-subsection of the tender, follow the movement of copy from author to typist to editor; back to the author and on through the various stages of printing and correcting to the point where the tender is bound and shipped. Coloured riders on the index cards indicate the amount of copy resting with any one department. A dense cloud of riders will show that in spite of precautions there is congestion. If the congestion occurs before one of the traditional bottlenecks, appropriate steps can be taken to increase the staff or allot more overtime, for the tender must leave the office on schedule or else the effort is lost.

Mass Spectrometry

Isotopic analysis of uranium and other elements has to be carried out with great accuracy, since precise measurement of composition, as in determining enrichment factor, is of profound economic importance.

Determining Isotopic Composition

Several techniques are available for determining the isotopic composition of uranium including optical spectrometry; gamma spectrometry; mass spectrometry; fission counting; neutron activation; neutron absorption and zero power reactors. Although these methods offer individual advantages, they have one common disadvantage—that of requiring specialised and expensive equipment. Of all the approaches listed, the mass spectrometer has proved to be most valuable because of its accuracy. It is the only instrument available that will analyse uranium over the full range of isotopic compositions, from depleted to fully enriched in the uranium 235 isotope, to within 0·10 per cent. *Mass Spectrometry for Uranium Isotope Measurements*, by C. D. Tabor, has been published by the International Atomic Energy Agency and reviews developments in this field.

Analysis by Spectrometer

In the mass spectrometer, ions are formed by bombarding gaseous molecules with electrons or by thermal evaporation of ions from solid samples deposited on the filament in the ion source. The ions are accelerated by permitting them to traverse an electrostatic field over a range from several hundreds to several thousands of volts, depending on the design of the instrument. Next the ions are separated in a magnetic field where they traverse circular paths having radii proportional to the mass-to-charge ratio. Analysis is accomplished by placing collector targets in suitable positions to intercept the separated ion beams, thereby producing electrical charges on the targets. The charges create small electrical currents which are amplified and recorded.

Two Basic Forms

Mass spectrometers used for uranium isotopic abundance measurements are based on two concepts:

(1) Instruments using an electron bombardment ion source; these are most suitable for the analysis of gaseous samples.

(2) Instruments using a thermal ion source, which are more applicable for solid sample analysis, and for very small samples.

The second method is used when the samples are more readily convertible to a uranium oxide than to the hexafluoride, and particularly in analyses involving the use of isotopic dilution techniques.

Focusing and Ion Velocity

A further division is also possible into single or double focusing, but for the analysis of uranium the former is usually satisfactory. Since the spectrometers using first order directional focusing are sensitive to ion momentum rather than to ion mass, the ions introduced into the mass analyser must be essentially monoenergetic for the analyser to differentiate between those of different mass. Thus the ion source must be designed to produce and accelerate monoenergetic ions. The angle of deflection may be any value up to 180°. The choice involves a compromise between the longer ion trajectory for small angles and the heavier magnets required for the large deflection angles. Fig. 1 shows an instrument with a deflection of 60°: in the case of the 180° instrument the radius of curvature will include a complete semicircle.

Performance Characteristics

Two main factors govern the performance of the spectrometer; the sensitivity and the resolution:

(1) The sensitivity is affected by the efficiency of the ion formation process and the ion optics in the source. Thus the sensitivity may be influenced by the size of the collimating slits and the magnetic field refocusing properties.

(2) Resolution is the ability to separate ions of adjacent masses and is affected by the degree of collimation achieved in the source, the refocusing action of the magnetic source, and the instrument geometry.

Essential Components

Mass spectrometers to be used for isotopic abundance measurements must include the following: (1) a suitable introduction system into the ion source; (2) an ion source able to produce a steady and adequate source of approximately monoenergetic ions and to accelerate these ions into the magnetic field; (3) a magnetic-field mass analyser with a performance stability consistent with the resolution requirements; and (4) an ion detection system for the electron bombardment instrument to measure ion currents of approximately 10^{-11} A to within 0·01 per cent.

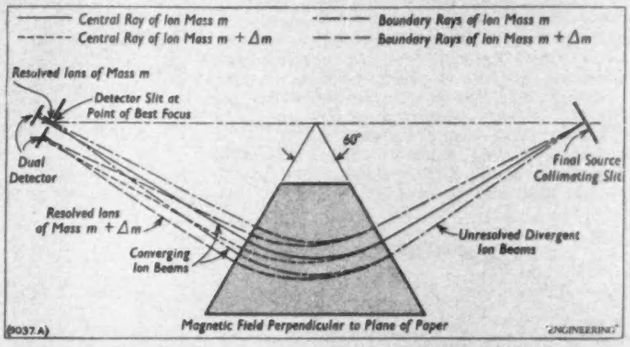

Central Ray of Ion Mass m
Central Ray of Ion Mass m + Δm
Boundary Rays of Ion Mass m
Boundary Rays of Ion Mass m + Δm
Resolved Ions of Mass m
Detector Slit at Point of Best Focus
Dual Detector
60°
Final Source Collimating Slit
Resolved Ions of Mass m + Δm
Converging Ion Beams
Unresolved Divergent Ion Beams
Magnetic Field Perpendicular to Plane of Paper
(9037.A)
"ENGINEERING"

Fig. 1 (right) Analysing instrument using a 60° deflection angle.

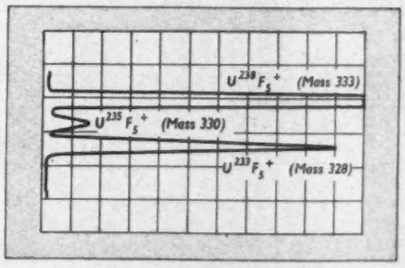


Fig. 2 Scanning of isotopic ion peaks. In the uranium hexafluoride gas samples, the positively charged UF_5^+ ions are the most predominant.

Preparation for Analysis

It is often necessary to alter the uranium into a form suitable for the instrument into which it is to be introduced. Several methods are possible for the conversion to uranium hexafluoride, which is used in electron bombardment instruments, as indicated in the USAEC report prepared by Goodyear Atomic Corporation, *Works Laboratory Instruments*, GAT-115/Rev.1 (1957), Vol. 1. Similarly for the thermal ion source instruments, some preliminary treatment may be required before insertion into the instrument. The United States National Bureau of Standards has established a set of uranium isotope standards and this has necessitated very careful analyses at varying concentrations of the uranium 235 isotope. Hexafluoride blending and oxide blending are two methods used to prepare standard materials at other concentrations if two sets of base materials of widely different isotopic concentrations are available.

Memory Effect

A disadvantage of the electron bombardment method is that the uranium hexafluoride reacts with the exposed surfaces. This produces a memory effect with the result that the analysis of a particular sample tends to be biased in the direction of the isotope composition of the last sample, which can greatly affect and limit the precision of the instrument. Development has progressed in reducing the memory effect by the suitable preparation of the uranium hexafluoride; it is also necessary to produce a very pure sample. The thermal emission ion source mass spectrometer is not as susceptible to the memory problem and it is possible to pay more attention to the analytical procedures of sensitivity and accuracy.

Peak Recording

The comparison with standards is more generally used with the electron bombardment instrument. Fig. 2 shows the scan of isotope peaks. Prior to the recording of the peaks the total ion current for several uranium isotopes is adjusted to a suitable required intensity and allowed to stabilise. The recording of the peaks is achieved by sweeping the accelerating voltage or magnetic field current in a way to obtain a scale of the ion beams.

Notes and News

New Cobalt 60 Price Schedule

The United States Atomic Energy Commission has revised its prices for cobalt 60 and established a new schedule of discounts for large quantity purchases. The aim is to encourage the use of ionising radiations as a major industrial and biological tool. A charge of $1 per curie for all material in quantities greater than 100,000 curies has been set, and in this case no regard is paid to the specific activity The charges do not include source selection, handling or shipping charges.

Specific Activity (curies per gram)	*List price per Curie*
1 to 25	$2·00
26 to 40	3·00
40 to 55*	4·00

Discounts

0 to 5,000 curies	List price
5,001 to 25,000 curies	List price less 25 per cent
25,001 to 100,000 curies	List price less 50 per cent
greater than 100,000 curies	All material for $1·00 per curie

* Specific activities greater than 55 curies per gram are out of the normal production range.

End of the Road for NTP

Design work on the Nuclear Test Plant which was to be built in the USAEC's Army Reactor Experimental Area near Idaho Falls has ended. The decision was based on changes in the programme for the military requirements of field nuclear power plants. The NTP was to have used a water-cooled reactor system having good flexibility and extensive instrumentation to facilitate the full-scale testing of prototype

reactor cores and reactor control systems of various designs.

Mirror Machine Gives High Ion Temperatures

A higher temperature has been held for a longer period than before by confining heavy hydrogen plasma in a magnetic mirror machine at the University of California. A plasma condition corresponding roughly to a temperature of 35 million degrees Centigrade was obtained, and the confinement time increased to about one thousandth of a second. In previous experiments plasma had been contained for only millionths of a second. Of greatest significance was the achievement of high ion temperatures; in the past the energy input had largely been absorbed in heating the electrons, leaving the ions relatively cold. Also the number of neutrons emitted is reported to be in the region of 10,000. Dr. F. H. Coensgen described the experiments as an "encouraging advance."

Vibrational Compaction

A method of compacting nuclear fuel element powders has been devised by the USAEC'S Hanford plant operated by US General Electric. A 24 kW amplifier and giant speaker system is used. Fuel element cladding tubes up to 8 ft in length are attached to the speaker or vibrator system which is driven by a large electromagnet delivering a thrust of nearly 5,000 lb. As the nuclear fuel is poured into the tubes they are vibrated at frequencies ranging between 5 and 5,000 cycles per second, thereby compacting the fuel to more than 90 per cent of its theoretical density in about three minutes. During the process accelerations of more than 100 *g* have been applied to the tube without dimensional changes or other adverse effects, and fuel rods with walls as thin as 0·005 in have undergone vibrational compaction without damage. The process is hoped to make a substantial reduction in the cost of fuel element construction.

Third Party Liability

Signing of the OEEC convention on third-party liability in the field of nuclear energy by six countries (and it is hoped that more will follow) has done much to clarify the many uncertainties that existed. It covers in considerable detail the transport of fissile material to and from an establishment and the position at which it changes ownership, and deals fully with the construction and operation of nuclear stations.

Plutonium-in-Air Monitor

Among the advanced nucleonic instruments that the Atomic Weapons Research Establishment, Aldermaston, sent to the Fifth International Instruments and Measurements Conference in Stockholm was a plutonium-in-air alarm monitor (Fig. 4). This monitor gives rapid warning of the release of plutonium into the atmosphere by continuously sampling air at preset periods for plutonium alpha activity. The plutonium dust particles are impacted on to a zinc sulphide coated film that is measured continuously with an alpha scintillation counter. The impactor collects particles of about 1 micron, such as those of plutonium, more readily than it does smaller particles of radon or thoron decay products which are swept through. The instrument's discrimination efficiency in favour of the larger particles is about 10 to 1. The sampling unit incorporates the demountable impactor assembly, film spools, actuator mechanism and safeguard mechanism. The UKAEA have published a booklet giving details of instruments shown in the exhibition and a list of the instruments shown in the commercial exhibition.

Nuclear Energy Courses

The European Nuclear Energy Agency of the OEEC have published an addendum and corrigendum which completes the *Catalogue of Courses of Nuclear Energy in OEEC Countries* for the year 1960-61 (published initially in June, 1960). The information given includes the conditions for admission; the length of the course; and the principal apparatus used.

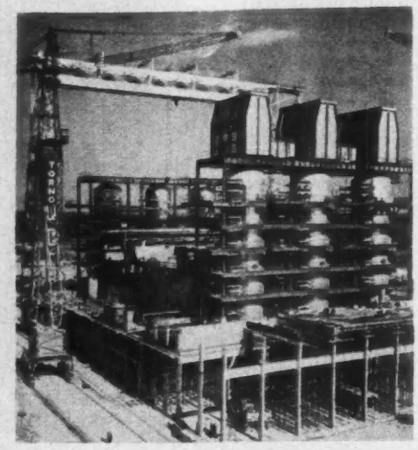


Fig. 3 The six heat exchangers in position at Latina Nuclear Power Station in Italy.

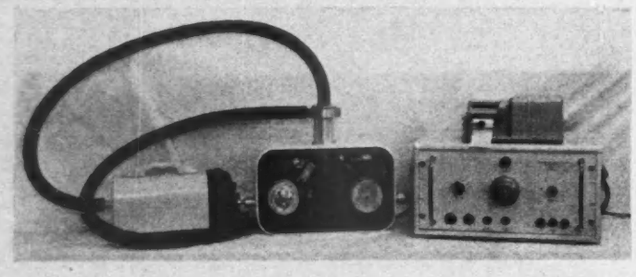


Fig. 4 Plutonium-in-Air Monitor continuously measures air samples for a rise in plutonium reactivity.

Atomic Energy Appointments

Senior appointments in their Development and Engineering Group have been announced by the United Kingdom Atomic Energy Authority. Mr. R. V. Moore, G.C., formerly director of reactor design, and Dr. H. Kronberger, O.B.E., formerly director of research and development, have been appointed as deputy managing directors. Mr. P. T. Fletcher, C.B.E., will be deputy managing director, general management. Mr. Moore will be deputy managing director, projects; and Dr. Kronberger will be deputy managing director, development. Mr. S. Fawcett, formerly deputy director, has succeeded Mr. Moore as director of reactor design. The Research and Development Directorate at Risley has been divided into two executive directorates. Dr. H. K. Hardy and Mr. F. W. Fenning have been appointed respectively as director of fuel element development and director of reactor technology. These appointments took effect from 10 October, 1960.

Neutron Cross Section Evaluation Centre

The USAEC has established a Neutron Cross Section Evaluation Centre at the Brookhaven National Laboratory to provide a centralised source of information on neutron cross-section data needed by reactor engineers, designers and physicists. Information will be available to the nuclear industry. Requests will be filed on a schedule of priority based on the general importance of the data required and the availability. The centre will assess cross-section measurements and make theoretical extrapolations of data.

Accelerator Notes

Accelerator for Australia: A tandem electrostatic generator, built in the United States, is now being installed at the Australian National University, Canberra. It will have an energy of 12 MeV and can accelerate particles ranging from hydrogen to oxygen. This unit is said to be more flexible than other types of accelerators, which are usually limited to accelerating only one or two types of particles.

. . . and South Africa? The South African mining industry has made an offer of £100,000 towards the cost of a particle accelerator and ancillary buildings for the University of the Witwatersrand. The mining industry have also contributed £800,000 for the development of nuclear research in the Union.

Romania Joins In: Romania has successfully tested her first particle accelerator: it is a 15 MeV betatron of her own design.

Reactor Notes

Medical Centre: An advanced 100 kW Triga tank reactor is to be built at the Medical Centre Grounds in Bethesda, the facility being known as the Defense Atomic Support Agency Triga reactor. The reactor will be used as a source of neutron and gamma radiation and will be allowed to run at 1,000 kW for periods up to 10 minutes and high power pulses are also proposed.

Advanced Test Reactor: Design of an Advanced Test Reactor has been authorised by the USAEC. The proposed project will operate at 250 kW at a pressure of 300 lb per sq. in and a temperature of 130° F with a coolant flow of 30,000 gallons per minute.

Universities: Three more American Universities have been granted or are in the process of obtaining operation licences for research reactors. The University of Washington has recently constructed a 10 kW light-water cooled and moderated reactor made by the AMF Atomic Division. The General Electric Company have installed and designed a 10 kW pool-type water moderated, reflected and cooled reactor using highly enriched uranium at the University of Wisconsin. The University of California has installed a 10 kW "Educator" reactor made by American Machine and Foundry Company. The loading is 33 kg of 90 per cent enriched uranium and it is possible to increase the power rating later if required.

First Deliveries: The arrival of the uranium fuel has begun at Berkeley power station from the Springfield refinery.

Germany's First: Work, which began on 16 June, 1958, has now been completed on the 15 MW(e) boiling-water reactor near Kahlen Main. It will be operating later this year, the main objective being experimental purposes. In a second phase of construction the power level will be stepped up to 30 MW(e) by applying forced circulation instead of natural convection, and installing a second turbogenerator set. The station was built by AEG.

Pakistan: The Pakistan AEC is establishing an institute of nuclear science and technology at Islamalad, the new capital, with a swimming pool reactor. Two nuclear training centres are to be set in Lagorea and Dacca, four medical radioisotope centres at Karachi, Multan, Lahore and Dacca, and two agricultural radioisotope centres.

Finland: Approval has been granted for the transfer of a 100 kW Triga reactor plus the fuel to Finland. The transfer will take place under a tripartite agreement between the United States, Finland and the International Atomic Energy Agency. It is expected to be in operation next year and will be used at Finland's Institute of Technology, near Helsinki, for training and research.

The 'Engineering' Appointments Section

MECHANICAL ENGINEERS

Young mechanical engineers with imagination will enjoy the challenge of design and development work in I.C.I. Nobel Division. Some posts are vacant and will be filled by men with degrees in mechanical engineering who are under thirty years of age.

For men of quality, prospects of rapid promotion are excellent, in an environment that encourages original effort.

The vacancies are in the West of Scotland, on the Ayrshire Coast of the Firth of Clyde, an area that offers opportunities for golf, sailing and mountaineering. The Company operates a 5-day week, a Profit-Sharing Scheme and a Staff Pension Fund.

Assistance towards house purchase is available for married men who will also receive a refund of reasonable removal and travel expenses.

Brief personal details should accompany applications to

The Staff Manager,
IMPERIAL CHEMICAL INDUSTRIES LIMITED
Nobel Division,
460 Sauchiehall Street, Glasgow, C.2

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D 453

PUBLIC APPOINTMENTS

TECHNICAL WRITER

required in the Sales Promotion and Development Branch of the NATIONAL COAL BOARD. The principal duties will be in the preparation of promotional booklets and literature related to the use of solid fuel in industry and commerce. Applicants should have experience in the technical journalism of steam and combustion engineering, or practical experience in these subjects and the ability to write effectively on them. Appointment superannuable, salary depending on qualifications and experience within £1190-£1560.—Write for application form to STAFF DEPT. (X.2046 B), N.C.B., HOBART HOUSE, LONDON, S.W.1, before 2nd DECEMBER, 1960. D 440

WESTERN REGION
of
BRITISH RAILWAYS

requires:—

ENGINEERING ASSISTANTS (capable of supervising Drawing Office staff) experienced in the design of reinforced concrete bridges and other structures to fill vacancies in posts in the salary range £1095/1150.

Interesting work in pleasant conditions with promotion on MERIT;
Superannuation Fund;
Reduced rates of Travel and other concessions;
Five-day week.

Applications, giving age, qualifications and experience, to:—

Chief Civil Engineer
British Railways
Western Region
Paddington
London, W.2. D 435

THE UNIVERSITY OF LIVERPOOL

Applications are invited for the post of DEMONSTRATOR in the DEPARTMENT OF MECHANICAL ENGINEERING. The salary will be within the range £650-£750 per annum, according to age, qualifications and experience.

Applications, stating age, academic qualifications and experience, together with the names of two referees, should be received not later than 30th NOVEMBER, 1960, by the REGISTRAR, from whom further particulars of the conditions of appointment may be obtained. CV/E. D 434

LOUGHBOROUGH COLLEGE OF TECHNOLOGY

INTRODUCTORY COURSES ON ERGONOMICS

The College provides A THREE WEEK introductory course on ERGONOMICS, for engineers, designers, industrial medical officers, work study engineers, factory managers and all senior staff who are called on to deal with human factor questions. The aim of the course is to impart a general knowledge of the capabilities and limitations of human performance at industrial work tasks. Such factors as the ergonomics of work place layout, factory operation and maintenance, noise, lighting and seating in factories and offices, will be considered in relation to the design of equipment and the industrial effectiveness and well-being of employees. This short course will enable those who take it to appreciate the applications of ergonomics in their own industries.

Dates of the next course: Monday, 6th March, 1961, to Friday, 24th March, 1961.

Fees £75 including tuition, board and residence.

Applications and further details may be obtained from the HEAD OF THE DEPARTMENT OF ERGONOMICS AND CYBERNETICS, COLLEGE OF TECHNOLOGY, LOUGHBOROUGH, LEICESTERSHIRE. D 439

THE MANCHESTER COLLEGE OF SCIENCE AND TECHNOLOGY

(FACULTY OF TECHNOLOGY IN THE UNIVERSITY OF MANCHESTER)

The Governing Body invites applications for A LECTURESHIP IN MECHANICAL ENGINEERING in the College, with corresponding title and status in the University of Manchester.

Candidates should have a major interest in Production Processes, particularly Metal Cutting, Metal Forming or Automatic Control. The successful candidate will be required to assist in the development and teaching of Courses on these topics and to undertake research for higher degrees. Salary, according to qualifications and experience, in the scale £1050 by £50 to £1400 by £75 to £1850 per annum. F.S.S.U. and family allowances.

Conditions of appointment and form of application may be obtained from the Registrar, The Manchester College of Science and Technology, Manchester, 1. The last day for the receipt of applications is SATURDAY, 17th DECEMBER, 1960. D 437

opportunities for DRAUGHTSMEN

Imperial Chemical Industries Limited

PLASTICS DIVISION

has vacancies for Draughtsmen at its headquarters at Welwyn Garden City.

The Plastics industry is expanding rapidly and to meet the Division's big development programme, which includes work on novel processes, there are openings for men with a Mechanical, Electrical or Instrument design background. Experience in work associated with process plant, *e.g.*, drying, powder conveying and packing, piping, heating and ventilating, would be an advantage and candidates should preferably hold at least an Ordinary National Certificate.

Good starting salaries will be paid and Pension and Profit Sharing schemes are in operation. For married men a temporary lodging allowance may be granted and assistance is given towards removal expenses.

Apply briefly, quoting reference No. 5055,/*A.P., to the Staff Manager,*

Imperial Chemical Industries Limited, Plastics Division

Bessemer Road, Welwyn Garden City, Herts.

D 451

BRITISH BROADCASTING CORPORATION

requires Engineer in Planning and Installation Department, London,

initially to undertake work on power installations for transmitter and studio premises. Preference given to applicants capable of extending their field of activity to installation, testing and commissioning of radio frequency equipment. Opportunities to gain necessary experience. Applicants must be British subjects preferably holding qualifications recognised for Graduate Membership of I.E.E. and should have had site installation practice and practical experience in manufacturer's works. Specific experience of diesel alternator installations desirable but not essential. Salary, commensurate with qualifications and experience, in scale £1230 to £1580 p.a. Requests for application forms to

Engineering Recruitment Officer, Broadcasting House, London, W.1.

quoting reference: 60.*E*.163 *Engg.*

D 444

ELECTRICAL AND MECHANICAL ENGINEERS

WAR DEPARTMENT DIRECTORATE GENERAL OF WORKS

Vacancies exist for professional MECHANICAL AND ELECTRICAL ENGINEERS at HEADQUARTERS AT CHESSINGTON, and elsewhere in U.K. and overseas.

The work of this recently formed, entirely civilian, organisation is similar to that carried out by a consulting engineer with a practice related to large building installations, but with greater emphasis on managerial responsibility, and it provides opportunities for foreign travel.

It covers a wide and interesting field including design, execution and management of electrical supplies and installations, heating, ventilating and air-conditioning, refrigeration, water supplies and a variety of specialised services in War Department centres at home and overseas. These centres consist of large groups of buildings including hospitals, stores, workshops, schools and living accommodation.

Emphasis is placed on the use of advanced techniques and there is a "Development Group" with a laboratory and testing facilities concerned with this aspect. Staff are encouraged to keep abreast of the latest developments and to specialise in selected fields of particular interest to the individual.

Importance is attached to the incorporation into new designs of ideas arising from the experience gained in operation and maintenance. In view of the heavy expenditure on maintenance much attention is devoted to such subjects as fuel economy, planned maintenance and work study.

IF YOU ARE ABOUT THIRTY, a Electrical member of the Institution of Mechanical or corporate Engineers (or expect to be one within two years), you should be suitable for a post as Engineer at a starting salary between about £1300 and £1500 rising to £1780. If you have a little more experience you may be suitable for appointment as Senior Engineer at a salary up to £2000. These salary scales are at present under review. Younger or less experienced men can enter as Assistant Engineers at a salary dependent on age and ability. For all grades a University degree is an advantage and a broad engineering background desirable.

There are prospects of promotion to higher posts up to £3000 and possibly above.

IF YOU HAVE JUST GRADUATED, a training scheme is available to qualify you for corporate membership of the Institution of Mechanical or Electrical Engineers. Graduates are paid £710-£770 while training.

Some of the posts would be attractive to OLDER MEN WITH EXPERIENCE in maintenance and managerial work. There is no age limit.

Working conditions include a five-day week and on first appointment from 4 to 5 weeks leave a year as well as public holidays; sick pay and assistance for external training. Overseas tours of service are normally for three years with comprehensive allowances; family passages and children's education. There will be opportunities later for pensionable appointments with transfer, where possible, of existing superannuation.

Apply giving age, brief relevant details of education, qualifications and experience in date order, to:—

MR. C. L. CHAMPION, B.Sc. (Eng.), A.C.G.I., M.I.C.E., M.I.Mech.E., M.I.E.E.,
CHIEF MECHANICAL AND ELECTRICAL ENGINEER,
WAR OFFICE, CHESSINGTON, SURREY.

Please mention any geographical preference for first appointment and state the lowest grade acceptable. This will not prejudice consideration of the applicant for a higher grade. D 465

LECTURER

NATIONAL FOUNDRY COLLEGE WOLVERHAMPTON

The Governors of the College invite applications for the post of LECTURER. A University Degree or its equivalent is essential and qualifications in Management would be a distinct advantage. Candidates should have had a sound training in the Foundry Industry with experience in Foundry Management, Methods and Planning.

The Salary will be in accordance with the Burnham Scale (£1370—£1550).

Full particulars may be obtained from the

CLERK TO THE GOVERNORS,
EDUCATION OFFICES,
NORTH STREET,
WOLVERHAMPTON.

D 456

STRUCTURAL ENGINEERING DESIGN DRAUGHTSMEN

AIR MINISTRY, Works Design Branch, requires in LONDON STRUCTURAL ENGINEERING DESIGNER DRAUGHTSMEN for reinforced concrete or structural steelwork of all types. Applicants must have adequate training and several years' experience. Some site experience and possession of recognised technical qualification an advantage. Financial assistance and time off may be allowed for recognised courses of study. Promotion and pension prospects. Five-day week with 18 days paid leave per year initially.

Salary ranges from £805 (at age 25) to £980 p.a. Commencing salary dependent on age, qualifications and experience. Applicants, who must be natural born British subjects, should write (quoting Order No. Kings Cross 3745), to AIR MINISTRY, W.G.d, LACON HOUSE, THEOBALDS ROAD, LONDON, W.C.1, or to any Employment Exchange, giving age, details of training, qualifications, full particulars of former posts held and copies of any testimonials. Candidates selected will normally be interviewed in London and certain expenses reimbursed. G 894

BRADFORD INSTITUTE OF TECHNOLOGY

Applications are invited for the post of LECTURER IN MECHANICAL ENGINEERING

Candidates should be well qualified and industrial and research experience would be a recommendation. The successful candidate will be required to teach one or more subjects to honours degree or Diploma in Technology standard. Adequate facilities will be given to undertake research and suitable assistance and equipment is available.

Salary scale: £1370-£1550 per annum.

Previous industrial and research experience, at a suitable level, will be taken into account in fixing the commencing salary.

Further particulars and forms of application may be obtained from the Registrar, Bradford Institute of Technology, Bradford, 7.

HENRY PATTEN,
CLERK TO THE GOVERNORS.

D 441

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY

MECHANICAL ENGINEERING DEPT.

RESEARCH ASSISTANT required to investigate high strain fatigue of metals. Honours degree and some design experience desirable. Salary, £550-£650 p.a. depending upon qualifications, with F.S.S.U. benefits.—Applications to PROF. H. FORD, IMPERIAL COLLEGE, LONDON, S.W.7. D 469

ADMIRALTY QUANTITY SURVEYING ASSISTANTS

NAVY WORKS DEPARTMENT

requires QUANTITY SURVEYING ASSISTANTS at Offices at Pinner (Middlesex), Chatham, Portsmouth, Portland, Liverpool, Greenock and Rosyth.

Duties include abstracting and billing, preparation of estimates, site measurements, settlement of final accounts, etc. Possession of qualifications such as City and Guilds, O.N.C. (Building or Builders Quantities) an advantage. Assistance given for recognised courses of study to enable technical qualifications to be obtained.

Promotion and pension prospects. Five-day week, 18 days Annual Leave rising to 22 days after 10 years.

SALARIES (National Rates subject to slight variation depending on location):—

Grade II £950 p.a. on entry to £1085.
Grade III £670 p.a. at age 21 to £850 p.a. at age 28 or over. Maximum £950
Grade IV £520 p.a. at age 20 to £710 at age 28 or over. Maximum £850.

Candidates must be British subjects and should apply in writing giving details qualifications and experience to:—

Director General, Navy Works,
ADMIRALTY
CHAMBERLAIN WAY, PINNER, MIDDLESEX

D 409

ENGINEERS

CIVIL, STRUCTURAL, AND PUBLIC HEALTH ENGINEERS. Pensionable posts for men and women at least 25 and under 35 on January 1, 1960 (extension for regular Forces service, Overseas Civil Service, established Civil Service and temporary Government service as Civil, Structural, or Public Health Engineer). Candidates must have achieved Corporate membership of an appropriate professional Institution or have passed examinations necessary for attaining such membership. Salary (men, London), £830-£1125, according to age, rising to £1300. Promotion prospects.—Write CIVIL SERVICE COMMISSION, 17 NORTH AUDLEY STREET, LONDON, W.1, for application form, quoting **S/64-66.** D 463

SCIENTIFIC OFFICERS

THE SCIENTIFIC CIVIL SERVICE needs men and women for pensionable posts as (*a*) SENIOR SCIENTIFIC OFFICERS and (*b*) SCIENTIFIC OFFICERS in all major scientific fields, including

PHYSICS
ENGINEERING
CHEMISTRY
METEOROLOGY
MATHEMATICS and
BIOLOGICAL SUBJECTS

Age limits: (*a*) at least 26 and under 32, (*b*) at least 21 and under 29. Extension for regular Forces service and Overseas Civil Service. Qualifications: normally first or second class honours degree in science, mathematics or engineering, or equivalent attainment; additionally for (*a*), at least 3 years' relevant (*e.g.*, post-graduate) experience. Selection by interview. London salaries (men): (*a*) £1330-£1640, (*b*) £730-£1205; provision for starting pay above minimum. Promotion prospects.—Write CIVIL SERVICE COMMISSION, 17 NORTH AUDLEY STREET, LONDON, W.1, for application form, quoting (*a*) **S/53/60,** (*b*) **S/52/60.** D 462

MINISTRY OF AVIATION

MINISTRY OF AVIATION (Chislehurst, Kent) require TECHNICIAN to assist in the formulation of radiographic inspection techniques and general radiographic and non-destructive testing investigation work. QUALIFICATIONS: Recognised engineering apprenticeship or equivalent training. O.N.C., C. & G. Final Certificates or equivalent. Wide experience in X and Gamma radiography on a large range of materials and enclosed assemblies. Experience of preparation and interpretation of X-ray crystallograms and of ultrasonic methods of flaw detection an advantage. Good knowledge of health physics and protection against ionising radiation hazards essential. Prospects for promotion and pension. Technical College courses sponsored for suitable candidates. SALARY: £975-£1115.—Application forms from MANAGER (PE 3525), MINISTRY OF LABOUR, PROFESSIONAL AND EXECUTIVE REGISTER, ATLANTIC HOUSE, FARRINGDON STREET, LONDON, E.C.4. D 461

TECHNICIAN

WAR OFFICE require TECHNICIAN at Woolwich for preparation of specifications and inspection instructions, and vetting of drawings in connection with the issue of manufacturing details for a variety of armament stores. QUALIFICATIONS: Recognised engineering apprenticeship, O.N.C., C. & G. Final Certificates, or equivalent. Experience in manufacture and inspection of small components and assemblies in quantity production. Knowledge of light mechanisms an advantage. SALARY: £875-£975.—Application forms from MANAGER (PE 3524), MINISTRY OF LABOUR, PROFESSIONAL AND EXECUTIVE REGISTER, ATLANTIC HOUSE, FARRINGDON STREET, LONDON, E.C.4. D 460

THE SCIENTIFIC CIVIL SERVICE

THE SCIENTIFIC CIVIL SERVICE needs men and women for pensionable posts as (*a*) EXPERIMENTAL OFFICERS and (*b*) ASSISTANT EXPERIMENTAL OFFICERS in Mathematics, Physics, Meteorology, Chemistry, Metallurgy, Biological Sciences, Engineering, Miscellaneous (Geology, Library and Technical Information Services). Candidates must, on December 31, 1960, be at least 26 and normally under 31 for (*a*) and at least 18 and normally under 28 for (*b*). Qualifications should normally include H.S.C., or G.C.E., or equivalent, or H.N.C. or University degree. Provisional admission if taking examinations in 1960. Men's salary scale (London) (*a*) £1075-£1325; (*b*) £447 10s. (at 18) to £794 (26 or over) rising to £970. Promotion prospects. Further education facilities.—Write CIVIL SERVICE COMMISSION, 17 NORTH AUDLEY STREET, LONDON, W.1, for application form, quoting **S/94-95/60.** D 459

SENIOR EXPERIMENTAL OFFICER

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Pensionable post at National Engineering Laboratory, East Kilbride, Glasgow, for man or woman at least 35 on January 1, 1961, to lead and expand a team concerned with collecting and disseminating technical information required by the Laboratory's mechanical engineering research staff. Qualifications: normally a university degree in Engineering or a physical science, or equivalent. At least 5 years' responsible experience in an industrial or research library, and knowledge of information techniques, essential. Salary scale, £1410-£1750. Starting pay may be above minimum. Promotion prospects. Housing available for married staff.—Write CIVIL SERVICE COMMISSION, 17 NORTH AUDLEY STREET, LONDON, W.1, for application form quoting **S/S230/60.** Closing date 22nd DECEMBER, 1960. D 458

ASSISTANT MECHANICAL AND ELECTRICAL ENGINEERS

AIR MINISTRY require ASSISTANT MECHANICAL AND ELECTRICAL ENGINEER for design construction and maintenance of installations on airfields, radar stations, missile bases, workshop and maintenance units for the R.A.F. at home and overseas as well as certain Civil Airports. Salary: £805 at 25 to £1095 at 34 or over, thereafter rising to max. £1260 with increase for London and slight decrease for country districts. Appointments long term with promotion and pension prospects. Five-day week with 4 weeks 2 days leave a year initially. Special allowances payable in addition to salary during overseas service.

Minimum qualifications and experience:—

(i) (*a*) University degree or equiv. diploma in electrical and/or mechanical engineering with at least 2 years apprenticeship; or

(*b*) Graduate or corporate member of I.E.E. with at least 3 years apprenticeship; or

(*c*) Graduate or corporate member of I.Mech.E. appreciable electrical engineering experience with at least 3 years apprenticeship; and

(ii) Have been employed for minimum of 2 years with well established engineering concern and gained wide experience in both electrical and mechanical engineering practice.

Applicants must be natural born British subjects between ages of 25 and 45.

Forms from MINISTRY OF LABOUR, TECHNICAL AND SCIENTIFIC REGISTER (K), 26, KING STREET, LONDON, S.W.1, quoting D.158/OA. G 897

WIGAN AND DISTRICT MINING AND TECHNICAL COLLEGE

Applications are invited for a post as ASSISTANT GRADE B in the DEPARTMENT OF MECHANICAL ENGINEERING. Duties will commence on 1st JANUARY, 1961, or as soon as possible thereafter.

Candidates should be graduates or hold equivalent professional qualifications, and have teaching or industrial experience.

Salary scale, £700 by £27 10s. (15) and by £37 10s. to £1150 per annum with additions for graduate status and training. Full allowance is given for relevant experience.

Further particulars and application form will be sent by the undersigned. Last date for the receipt of applications: FRIDAY, 9th DECEMBER, 1960.

E. C. SMITH,
PRINCIPAL.

NOVEMBER, 1960. D 471

COUNTY BOROUGH OF BURNLEY EDUCATION COMMITTEE BURNLEY MUNICIPAL COLLEGE ENGINEERING DEPARTMENT

LECTURER IN ELECTRICAL ENGINEERING required to teach electrical subjects up to H.N.C. Level and for the Part III I.E.E. Examination.

Candidates should have a degree in electrical engineering and corporate membership of the Institution of Electrical Engineers together with teaching and industrial experience.

Salary Scale—£1370 by £35 to £1550 per annum.

Application forms from the Director of Education, Education Office, by whom completed forms must be received not later than 14 days after the issue of this advertisement.

C. V. THORNLEY,
Town Clerk. D 442

SCIENTIFIC ASSISTANTS

THE SCIENTIFIC CIVIL SERVICE needs men and women for pensionable posts as ASSISTANTS (SCIENTIFIC). Ages at least 17½ and normally under 26 at January 1, 1960 with appropriate educational or technical qualifications (normally G.C.E. with passes at "O" or "A" level in 4 distinct subjects including English Language and a scientific or mathematical subject, or O.N.C., or equivalent qualification) and at least 2 years' experience in either: (i) engineering or physical sciences, or (ii) chemistry, biochemistry or metallurgy, or (iii) biological sciences, or (iv) geology, meteorology, or skilled work in laboratory crafts such as glass-blowing. Starting salary (men, London) from £347 10s. (at 17½) to £550 (at 25 or over). Maximum (London) £715. Promotion prospects. Five-day week generally.—Write CIVIL SERVICE COMMISSION, 17 NORTH AUDLEY STREET, LONDON, W.1, for application form, quoting S/59/60. CLOSING DATE 31st DECEMBER, 1960. D 464

UNIVERSITY OF SYDNEY

Applications are invited for the following positions in the DEPARTMENT OF ELECTRICAL ENGINEERING:—

1. LECTURESHIP/SENIOR LECTURESHIP IN ELECTRICAL ENGINEERING
   Candidates should have good academic qualifications in Electrical Engineering, experience in some aspect of power engineering, and a working knowledge of electronic techniques. The successful applicant will take part in teaching, primarily in the field of electrical machines, and in research.
2. LECTURESHIP/SENIOR LECTURESHIP IN ELECTRICAL ENGINEERING
   Candidates should have good academic qualifications in Electrical Engineering or Physics, general experience in electronics and considerable detailed knowledge of solid state devices and circuits. The successful applicant will take part in the teaching of electronics and communication engineering, including fundamental aspects of solid state devices and circuits, and in research.
3. LECTURESHIP IN ELECTRICAL ENGINEERING
   The successful applicant will be expected to assist in the planning and teaching of control system engineering at graduate and undergraduate levels and to pursue original research in this or an allied field. Extensive computing facilities are available, as well as a well-equipped control systems laboratory.

The salary for a Senior Lecturer is within the range £A2550 by £A95 to £A3000 per annum; for a Lecturer within the range £A1730 by £A105 to £A2435 per annum. In each case cost of living adjustments will be allowed (at present £A29 p.a.). The salary is subject to deductions under the State Superannuation Act. The commencing salary will be fixed according to the qualifications and experience of the successful applicant.

Under the Staff Members' Housing Scheme in cases approved by the University and its Bankers, married men may be assisted by loans to purchase a house.

Further particulars and information as to the method of application may be obtained from the SECRETARY, ASSOCIATION OF UNIVERSITIES OF THE BRITISH COMMONWEALTH, 36 GORDON SQUARE, LONDON, W.C.1.

Applications close, in Australia and London, on 31st JANUARY, 1961. D 466

THE GOVERNMENT OF NORTHERN NIGERIA

requires **PUPIL EXECUTIVE ENGINEERS** on favourable contract terms for construction and maintenance of Roads and Bridges and for Water Works.

The work on which selected candidates will be employed will comply with the requirements of the Institution of Civil Engineers for the Professional Interview.

QUALIFICATIONS:

A University Degree or Diploma recognised by the Institution of Civil Engineers or passes in both Parts I and II of the Institution's Examinations. Post qualifications practical experience is not necessary but any such experience will be taken into account in determining the starting salary.

Applications will also be considered from candidates who are taking their finals in 1961.

EMOLUMENTS:

1. SALARY: First year £1104 p.a. gross, second year £1154 gross and thereafter on an incremental scale rising to £2202 p.a.
2. OUTFIT ALLOWANCE of £45 and Camp Equipment allowance of £40 on first appointment.
3. RESETTLEMENT GRANT of £37 10s. 0d. for each three months' service inclusive of earned leave payable on satisfactory completion of contract.
4. CHILDREN'S ALLOWANCE of £120 p.a. for one child, £216 for two and £280 for three children eligible.
5. FREE PASSAGES BY AIR OR SEA for officer and wife on appointment and on leave and assistance towards cost of children's passages.

LEAVE:

Generous home leave on full pay.

Applicants should write to :—

The Recruitment Secretary (Overseas)
Northern Region Recruiting Agency,
Nigeria House,
9, Northumberland Avenue,
London, W.C.2

or ring TRAfalgar 1244, *Ext.* 144.

D 475

CHIEF DESIGNER

for a leading manufacturer of earthmoving equipment located in the pleasant countryside of North-West England. This executive appointment will carry a starting salary in the bracket £1800-£2200 per annum which is open to subsequent improvement. Removal expenses will be met. Residential and educational amenities are excellent.

The Chief Designer will have responsibilities to the Managing Director for the execution of basic design and engineering development of a range of modern equipment. He will be a full member of the Product Development and Component Standardisation committees. In addition, he will control the preparation of technical publicity material including spare parts catalogues, instruction and service manuals.

Among the desired qualifications are experience of the control of design draughtsmen engaged on medium to heavy stressed fabrications, together with wide personal knowledge of the design of gears and transmission systems. Experience in the application of hydraulic systems would be an advantage. A.M.I.Mech.E. desirable. Age up to 50.

Please write briefly in first instance, quoting Reference No. 920, to:—

ASHLEY ASSOCIATES LTD.
PETER HOUSE, MANCHESTER 1.
RETAINED TO ADVISE ON THIS APPOINTMENT
The strictest confidence will be observed and no details of candidates will be passed to clients without candidate's permission.

D 443

ELECTRONICS

THE UNITED KINGDOM ATOMIC ENERGY AUTHORITY

require a

SENIOR ENGINEER

to take charge of all

INSPECTION AND FUNCTIONAL TESTING

at their establishment at Woolwich Common

The successful candidate who should be a Corporate Member of a Senior Engineering Institution will be responsible to the head of the establishment and, in addition to controlling the inspection team, will be responsible for development of inspection techniques.

SALARY:- £1,955—£2,255 p.a. including London Allowance.

Write for application forms to:—

SENIOR RECRUITMENT OFFICER,
A.W.R.E., ALDERMASTON, BERKS.

Ref. A.2739/26

D 450

MECHANICAL DESIGN DRAUGHTSMEN

SEVERAL HIGHLY QUALIFIED MECHANICAL DESIGN DRAUGHTSMEN

required for work on Advance Designs of Machine Tools and similar mechanisms involving original thought. To work closely with electronic development team. These vacancies are suitable for those with H.N.C. or higher qualifications, and a good salary will be paid, in addition to Group Life Assurance and Pension Scheme which is in operation. Applications in writing, giving details of age, experience, etc., to the Personnel Officer,

DAVID BROWN INDUSTRIES LIMITED,
MACHINE TOOL DIVISION,
SHERBOURNE STREET,
MANCHESTER, 3.

D 468

CENTRAL ELECTRICITY GENERATING BOARD

NORTH EASTERN AND YORKSHIRE REGION

THIRD ASSISTANT ENGINEER

EFFICIENCY AND TESTING SECTION

Applicants are invited for the position of THIRD ASSISTANT ENGINEER in the Efficiency and Testing Section of the GENERATION OPERATION DEPARTMENT, YORKSHIRE DIVISIONAL HEADQUARTERS, LEEDS.

Applicants should be educated to at least Higher National Certificate Standard in Mechanical Engineering and should have had experience of operation of modern power stations.

The successful applicant will be responsible for carrying out tests, investigations and efficiency studies on power station plant throughout the Division. He will be based at Skelton Grange Power Station but will be expected to travel in connection with his duties.

The salary for the appointment will be in accordance with the National Joint Board Agreement, Grade 6 BX, Schedule " B " (£1285-£1610 per annum)

This is a re-advertisement and previous applicants need not re-apply.

Forms of application may be obtained from the ASSISTANT REGIONAL SECRETARY (PERSONNEL), CENTRAL ELECTRICITY GENERATING BOARD, NORTH EASTERN AND YORKSHIRE REGION, 1 WHITEHALL ROAD, LEEDS 1, to whom they should be returned to arrive not later than the 9th DECEMBER, 1960.

D 479

UNIVERSITY OF GLASGOW

JAMES WATT CHAIR OF ELECTRICAL ENGINEERING

The University Court will shortly consider an appointment to the JAMES WATT CHAIR OF ELECTRICAL ENGINEERING. The Chair is a full-time appointment.

Particulars as to duties, salary and conditions of appointment may be obtained from the undersigned, with whom applications (20 copies) should be lodged, not later than 14th JANUARY, 1961.

ROBT. T. HUTCHESON,
SECRETARY OF UNIVERSITY COURT.

D 480

STATION ENGINEERS

AIR MINISTRY require STATION ENGINEERS (G.D.) and STATION ENGINEERS (MECH.) at R.A.F. and MINISTRY OF AVIATION STATIONS throughout the United Kingdom. The work of Station Engineers (G.D.) consists of installation, operation and maintenance of high and medium voltage electrical distribution systems, electrical power and lighting installations, control systems and generating plant: knowledge of heating and ventilating plant and diesel engines an advantage. Station Engineers (Mech.) are concerned with diesel power plant, steam and hot water heating systems, refrigeration and air conditioning and miscellaneous workshop plant, tools and equipment.

Candidates should hold O.N.C. Elec. or Mech./C. & G. Electrical Technicians Certificates/2nd Class M.O.T. Certificate, or equivalent, and must also have had recognised apprenticeship with firm of good repute plus 3 years' employment in electrical or mechanical and engineering, preferably on operation and maintenance of mine, factory or workshops plant and services. Preference to candidates with supervisory experience.

Commencing salary, which is dependent upon age, qualifications and experience, ranges from £745 (age 25) to £925 maximum in Grade III. There are pension prospects and also opportunities of advancement to numerous posts in the higher grades vacancies which, as a rule, are filled by promotion of Grade III staff, viz.:

Technical Grade II, £925-£1055 ...	276 posts
Inspector of Works Grade I, £1055-£1295	137 posts
Technical Grade B, £1295-£1491 ...	25 posts
Technical Grade A, £1385-£1630 ...	17 posts

Overseas tours for which special allowances ranging at present up to £1800 p.a. are payable in addition to a higher salary. Internal training courses are provided and financial assistance and time off is allowed for recognised courses of study leading to higher qualifications. 5-day-week with 18 days paid leave a year initially.

Applicants, who must be natural born British subjects, up to age 55, should write stating age, qualifications and experience, to the MANAGER (P.E.1), MINISTRY OF LABOUR, PROFESSIONAL AND EXECUTIVE REGISTER, ATLANTIC HOUSE, FARRINGDON STREET, LONDON, E.C.4. No original testimonials should be sent. Candidates selected will normally be interviewed in London and certain expenses reimbursed. Only applicants selected for interview will be advised.

G 903

TECHNICIAN

MINISTRY OF AVIATION, CARDIFF, require TECHNICIAN to be responsible for the mechanical and electrical safety aspects of a medium engineering factory. QUALIFICATIONS: Recognised engineering apprenticeship. O.N.C., C. & G. Final Certificates or equivalent. Knowledge of the requirements of the Factories Act and its applications. Prospects for promotion and pension. Salary: £950-£1085. Application forms from MANAGER (PE 3509), MINISTRY OF LABOUR, PROFESSIONAL AND EXECUTIVE REGISTER, ATLANTIC HOUSE, FARRINGDON STREET, LONDON, E.C.4.

D 457

AIR MINISTRY

AIR MINISTRY, Works Design Branch, requires in LONDON CIVIL ENGINEERING DESIGNER DRAUGHTSMEN with adequate training and drawing office experience in one or more of the following:—

(*a*) Roads, pavements, earthworks and stormwater drainage; (*b*) Foul drainage and sewage disposal; (*c*) Water supply distribution. Some site experience and possession of recognised technical qualifications an advantage. Financial assistance and time off may be allowed for recognised courses of study. Promotion and pension prospects. Five-day week with 18 days paid leave per year initially.

Salary ranges from £805 (at age 25) to £980 p.a. Commencing salary dependent on age, qualifications and experience. Applicants, who must be natural born British subjects, should write (quoting Order No. Kings Cross 3746). to AIR MINISTRY, W.G.d., LACON HOUSE, THEOBALDS ROAD, LONDON, W.C.1, or to any Employment Exchange, giving age, details of training, qualifications, full particulars of former posts held and copies of any testimonials. Candidates selected will normally be interviewed in London and certain expenses reimbursed.

G 895

APPOINTMENTS OPEN

ENGINEER SURVEYORS

ENGINEER SURVEYORS for inspection of Cranes and Lifting Plant required. Must have drawing office experience of design of Cranes also National Certificate Mechanical Engineering. Essex and Liverpool areas. Permanent. E.S.A. Scale salary commencing at £800 p.a. Other benefits.—Apply ENG. DEPT., GENERAL ACCIDENT ASSURANCE CORP., LTD., 99, ALDWYCH, W.C.2.

D 446

PLANNING ENGINEER

PLANNING ENGINEER required for expanding Company in the Midlands producing small pressed parts. This is an excellent opportunity for a man with initiative and enthusiasm.

Commencing salary in the range of £1000 to £1250, depending on experience and qualifications.—BOX G 902, Offices of ENGINEERING.

MANAGER

MANAGER required by an expanding Company in BEDFORDSHIRE manufacturing small metal components with automatic machinery. Experience of the Design and Manufacture of special-purpose machinery would be an advantage.

Write, stating age, experience and when available. —BOX D 475, Offices of ENGINEERING.

LINGUIST

LINGUIST required for technical work at VICKERS-ARMSTRONGS (ENGINEERS) LTD., BARROW-IN-FURNESS. The language chiefly required is Spanish, but a good knowledge of French and German also would be an advantage. Applicants should submit precise information as to their qualifications in this field, together with the extent of their engineering technical knowledge, past experience, etc., to the LABOUR MANAGER at the above address.

D 483

Proving Engineer

A Mechanical Engineer is required for the Proving Department of a large light engineering manufacturing company in North West London.

Applicants should have H.N.C. in mechanical engineering or equivalent. Membership of a professional institution would be an advantage. Age preferably between 25 and 35.

Conditions of service are good and the post offers an attractive salary.

Write in confidence to Box D 481, OFFICES OF ENGINEERING.

TECHNICAL SALES REPRESENTATIVE

VENTILATION SILENCING. Specialists in the design, manufacture and marketing of high efficiency silencers for air-conditioning ventilating systems, require a live man with full knowledge of all aspects of ventilation to act as their Technical Sales Representative, principally in the London Area. Salary, expenses and pension Sheme in operation. Full details in writing to SOUND CONTROL LTD., COLNESIDE WORKS, TROUT ROAD, WEST DRAYTON, MIDDLESEX. D 482

RICHARD THOMAS & BALDWINS LIMITED

EBBW VALE

require a

POWER PLANT and GENERAL WORKS SERVICES ENGINEER

The successful applicant will be responsible for:—

(1) Generating Station and High Pressure Boiler Plant.
(2) Low Pressure Boiler Plant.
(3) Steam and Water Distribution and Pipework Installation.

Applicants should be qualified in Mechanical Engineering, and have a wide practical experience on Power Plant, Boilers and Pipework, as applied in Heavy Industry.

This is a senior appointment, and only men of proven ability will be considered. Age—35 to 50 years. Salary commensurate with experience. Superannuation scheme.

Application forms, which should be returned by 13th December, are available from:—

CHIEF ENGINEER,
RICHARD THOMAS & BALDWINS, LIMITED,
EBBW VALE SECTION, EBBW VALE, MON.

D 470

C. A. PARSONS & CO. LTD.

GRADUATE ELECTRICAL ENGINEERS or PHYSICISTS (preferably with good honours degrees and some practical experience) are invited to discuss opportunities offered in the Company's Research Department for work on various interesting projects in the field of HIGH VOLTAGE TECHNOLOGY.

Men with drive and initiative are required, who are able to undertake independently both fundamental and applied research work.

Initial applications to the Personnel Manager should give brief details of career and qualifications and indicate special interest in particular positions.

C. A. PARSONS & CO. LTD.,
Heaton Works,
Newcastle/Tyne, 6.

D 467

UNITED KINGDOM ATOMIC ENERGY AUTHORITY

invite applications from

JUNIOR PROFESSIONAL ENGINEERS

for

CIVIL, MECHANICAL AND ELECTRICAL POSTS

at their

WINDSCALE AND CALDER WORKS, SELLAFIELD, CUMBERLAND.

The posts are with the Production Group of the Authority and the work is concerned with the operation, control and maintenance of nuclear reactors and associated chemical plants. Salaries are within the scale £860, at age 25, to £1340 p.a. and the posts offer excellent prospects of a rewarding and satisfying career with the Production Group which is run on lines parallel to those of the most progressive private industry.

Applicants must have served a recognised engineering apprenticeship or pupilage and be corporate members of an appropriate Institution, or equivalent.

Working and living conditions are congenial. The surrounding district offers considerable amenities including excellent beaches, and easy access to the Lake District.

There is a Staff Housing Scheme and a Contributory Superannuation Scheme.

For further details of these posts, and form of application, you are invited to write, quoting reference P/W.59/J2, to:

Staff Appointments Officer,
UNITED KINGDOM ATOMIC ENERGY AUTHORITY,
PRODUCTION GROUP,
Windscale Works, Sellafield, Seascale, Cumberland.

D 436

SOUTH AUSTRALIA

Civil Engineers

For qualified men with an ambition to get on with a job, there are good opportunities for permanent appointment in the Engineering and Water Supply Department in South Australia, with Headquarters at Adelaide.

Vacancies exist in the design, construction, and maintenance branches, covering water supply and sewerage installations and other engineering projects.

Salary up to £A1920 per annum, according to experience and qualifications.

First class steamer passages for families provided.

Housing accommodation guaranteed.

Good holiday entitlement and generous superannuation arrangements, providing retirement pension and widows' pension in case of pre-decease.

Full details from:

AGENT GENERAL FOR SOUTH AUSTRALIA,
SOUTH AUSTRALIA HOUSE,
50 STRAND, LONDON, W.C.2

D 438

MSL *have been retained to advise on the appointment of a*

PRODUCTION MANAGER

Light Engineering

for a modern factory in the Home Counties, employing 150 on specialist equipment for a variety of industries. He will be responsible to the Managing Director for all aspects of production and works management. This will include planning and progress, costing and estimates and the economic control of all resources and manufacturing methods. Starting salary around £2,000, contributory pension scheme, and prospects of appointment to the Board within 5 years.

Candidates aged 36 to 45 must be time-served practical engineers, with up-to-date knowledge of welding and fabrication. They should have had time in a drawing office and essentially some experience of engineering management at least at assistant works manager level. Knowledge of aluminium founding, hydraulics or press work would carry weight. Please send brief details in confidence quoting reference F.3203 to H. C. S. Brand.

MANAGEMENT SELECTION LIMITED
17 Stratton Street, London, W.1

In no circumstances will a candidate's identity be disclosed to our client unless he gives permission after a confidential interview at which he will be given full details of the appointment.

D 447

SENIOR ENGINEERS

The ALMIN GROUP require

MECHANICAL, ELECTRICAL and INSTRUMENT ENGINEERS

to work on a major expansion programme in the light alloy field.

The preferred age range is 30-45. There will be generous starting salaries according to experience and qualifications. There is a pension fund and assistance may be given with removal and accommodation expenses.

The ALMIN GROUP is operated jointly by the ALUMINIUM COMPANY of AMERICA and IMPERIAL CHEMICAL INDUSTRIES LIMITED: it has associated factories at Barking, Slough, Aylesbury, Warwick, Northampton, and Swansea.

Applications, with full particulars, should be sent to:—

Mr. E. John Pike,
ALMIN LIMITED, ALMIN HOUSE, STOKE POGES, Bucks.

D 455

STRUCTURAL ENGINEER

THE ARCHITECT'S DEPARTMENT of the LONDON COUNTY COUNCIL has one vacancy for an ASSISTANT SENIOR STRUCTURAL ENGINEER (salary £1750-£2050). Opportunity for first-class designer to design and to lead others in the design of schools, houses, flats, homes for children, homes for old people, fire stations, hostels, factories, stores and warehouses (including foundations). Candidates should have experience of reinforced concrete, pre-stressed concrete, structural steelwork, timber and load bearing brickwork.

Starting point according to qualifications and experience. Particulars and application form, returnable by 31st DECEMBER, 1960, obtainable from:

HUBERT BENNETT, F.R.I.B.A.,
ARCHITECT TO THE COUNCIL,
(EK/E/2974/11),
COUNTY HALL, S.E.1.

D 448

British Titan Products Co Ltd

has vacancies for

MECHANICAL ENGINEERS

at its Grimsby Factory

The Company is a very active and flourishing Chemical Industry of international standing and its continuing expansion offers plenty of interest and scope for Engineers on plant maintenance and construction, wherein the present vacancies occur.

Preference will be given to candidates with a University degree in Mechanical Engineering, but those with an equivalent professional qualification will also be considered. Post-graduate Apprenticeship is essential and the upper age limit for the appointments is 30.

Salaries and prospects are very attractive for men with the right qualifications. Annual Bonus Scheme and Non-Contributory Endowment Assurance and assistance for married men with house purchase and removal expenses.

Applications in strictest confidence to be addressed to:—

The Personnel Manager,
BRITISH TITAN PRODUCTS COMPANY LIMITED,
BILLINGHAM, CO. DURHAM
quoting Ref. S.17.

G 901

WORKS MANAGER-DIRECTOR

A keen young engineer with first class knowledge of modern works management required by old established expanding Public Company pre-eminent in hire car/ P.S.V. operation. Factory employing 150 tradesmen situated in London. Applicants must have recent experience of similar position, involving fleet costing, budgetary control, etc. Starting salary £1500 p.a., pension scheme and usual benefits.

BOX D 427, Offices of ENGINEERING.

BROOKE MARINE LIMITED

A Company in the Dowsett Group

HIGH SPEED SMALL CRAFT

Require capable and qualified DESIGNER for the development of High Speed Planing Hulls and Hydroplanes.

Requirements:

(*a*) Age under 35.
(*b*) Engineering degree or equivalent.
(*c*) Extensive experience and proved ability in Hydrodynamics and Aerodynamics.
(*d*) Experience of normal practice in Naval Architecture advantageous.

Location: At Lowestoft, after an initial period at the Group's Central Development establishment in Lincolnshire.

Salary and Conditions: A liberal salary will be paid to the right man with excellent prospects for future promotion to positions of increasing responsibility as the work develops.

Applications, which will be treated in confidence, should give full personal particulars and details of past and present experience and present level of remuneration to:—

The Chairman,
Brooke Marine Limited,
Tallington, Stamford, Lincs.

D 449

ALLIS-CHALMERS GREAT BRITAIN LIMITED
have the following vacancies for draughtsmen:—

1 CHIEF DRAUGHTSMAN
to take charge of Drawing Office, engaged on agricultural and earth moving machinery design.

2 SENIOR MECHANICAL DRAUGHTSMEN
preferably with experience of Tractor or heavy vehicle design.

These are well paid appointments offered by a progressive and expanding Company. The work is varied and interesting, and the factory is pleasantly situated in the country with free local transport provided by the Company.

Applicants should apply to the
Chief Engineer,
Allis-Chalmers Great Britain Limited,
Essendine, Nr. Stamford, Lincs.

D 452

MECHANICAL ENGINEER

MECHANICAL ENGINEER, H.N.C. STANDARD, required for non-destructive testing of materials and vessels. Specialised training will be given to successful candidate. Commencing salary, £800 a year. Non-contributory pension.—BOX D 472, Offices of ENGINEERING.

TAKERS OFF AND WORKERS UP

Firm of CHARTERED QUANTITY SURVEYORS require TAKERS OFF and WORKERS UP for large Civil Engineering and Building works in the SHEFFIELD AREA. Positions offer scope for advancement.—Reply stating age, experience and salary required to BOX D 373, Offices of ENGINEERING.

ADVERTISEMENT RATES

'Engineering' Appointments Section

CLASSIFICATIONS: Public Appointments, Appointments Open, Appointments Wanted.

TYPES OF ADVERTISEMENTS:

(a) "Appointments Illustrated" and illustrated careers advertisements: photographs or drawings may be used in conjunction with type matter.

Rates:	per page (12 in. by 9 in.)	£100
	half page	£54
	quarter page	£29

(b) Semi-display: type matter, with or without surrounding rule, name block or symbol.

Rates:	per page (12 in. by 9 in.)	£100
	per half page	£54
	quarter page	£29
	per single column inch	£2 14s.

(c) Single column "run-on" advertisements: approximateiv 6 words to the line, 12 lines to the inch.

Rate per line	4s. 6d.

(Minimum charge 18s.)

SERIES DISCOUNTS: 5 per cent. on 6 insertions; 10 per cent. on 13; 15 per cent. on 26; 20 per cent, on 52.

BOX NUMBER: 2s.

COPY DATE: First post Monday.

BLOCKS: To be mounted ready for printing. Screen 100.

ORDERS TO: "Engineering" 36, Bedford Street, London, W.C.2. (Telephone TEMple Bar 3663).

Companies

Rootes Review Looks To Better Times for Cars

THE report and accounts from ROOTES MOTORS show clearly how swiftly the car industry's difficulties have accumulated and indicate some grounds for looking forward with confidence.

In the year ending with last July, the consolidated group profits before taxation were £4,186,698. Until the latter part of the financial year the group earnings had been running at a higher level than the final figure suggests.

The widely commented upon recession in sales in the United States and the effects of Government financial restrictions at home combined to upset the position while both cars and commercial vehicles from the Rootes group were meeting record demands.

In his annual review Lord Rootes observes that when the unbalanced stock position in the United States has been put right he looks forward to a resumption of satisfactory business. Confident in the expansion of the world demand for vehicles, the group continues with its increases in manufacturing capacity.

The new smaller Hillman car which is to be produced at Linwood, in Scotland, alongside the PRESSED STEEL works, will give the group a wider market and strengthen its dealer position.

Lord Rootes refrains from giving an opinion on how it is to be done but he hopes that as it is the declared policy of the employers and the unions that unofficial strikes should be eradicated there will be a rapid and major improvement in this field.

On the current year Lord Rootes says: "It would be wrong for me to be optimistic." The group can keep up its position by maintaining the standard of its cars, commercial vehicles and diesel engines, but profits will be reduced.

Cable War Effects Spoil a Good Record

There is now the basis for some stability in the cables market and reasonable profits can again be made by the manufacturers. This follows the price war in cables, one of whose effects was to cause a decline in the profits of the CROMPTON PARKINSON concern to an extent that entirely offset the improved trading profits of other sections of the group at home and overseas.

The final trading profit by Crompton Parkinson in the last financial year ended at £2,750,617—just £5,074 below the previous year's record level for the group.

The difficulties of the past year, the increasing competition and the continuing process of the dissolution of price structures are all known factors, but Mr. Albert Parkinson, the Crompton Parkinson chairman, goes one further when he predicts that these probably set the pattern for the immediate future.

At home the Chelmsford switchgear and instrument departments have been fully engaged and the machine and traction departments are in full production on orders for the British Railways modernisation scheme. Although the transformer field is one of the most competitive sections of the electrical capital equipment industry, especially overseas, the Hayes works of the company has benefited from an improvemend in the demand in the home market.

The reduction in the home consumer goods industry caused by Government credit restrictions has had an effect on the Doncaster works, especially in the field of fractional horse-power motors. The past application of the policy of basing production as widely as possible has succeeded in keeping the effects of the change as small as possible.

Of the outlook at large, the Crompton Parkinson chairman believes that a further intensification of competition is inevitable and that the regroupings which have taken place in the electrical industry will, in time, increase this even further. For Crompton Parkinson diversification will continue to be a key weapon in the campaign to keep up a steady trading performance.

Jaguar Still Maintaining Record Production Level

The JAGUAR CARS Company sounds a cheerful, if lonely, note from the motor manufacturers. While the redundancy notices and the short time working announcements come thick and fast from the big five motor companies, with the exception of Ford, Jaguar alone are able to announce that never before has production run so high in all the history of the company.

Within the first ten months of the year the company has exceeded the output of all 1959. The last month for which complete figures are available is September, and that was a record month for the firm.

There is no sign of the demand slackening either at home or overseas. The orders already on the books will "tax the company's manufacturing capacity to the limit."

From this it follows that the recently announced £2 million re-equipment scheme for the Jaguar and Daimler factories will be needed up to the hilt. It is intended to raise output by 20 per cent next year and by another 10 per cent after that.

Looking for the reason for the Jaguar prosperity it is not easy to decide whether the explanation is economic or one of engineering, or both. The Jaguar is not in the main a car bought on the personal and private income. It is much more in the class of the car bought by a company for the use of senior executives. The speeded up depreciation allowances of the sports car has played some part here.

At the same time the Jaguar company has been able to maintain an air of excitement about its cars and of technical advance, which, in another field, is still keeping the BRITISH MOTOR CORPORATION's Miniminors and Austin Sevens selling well.

Log Handling Plant For Czechoslovakia

The East London constructional company, MARCO CONVEYOR AND ENGINEERING, of Leytonstone, are to extend the scope of their export activities to include Czechoslovakia.

They will design, supply, and erect a log handling plant for the groundwood mill at Stetti, near Prague. The contract is worth more than £100,000.

Earlier export orders for the company have included foundry plant for Yugoslavia and a log handling plant in Portugal. Both these contracts are now approaching completion.

Family Doctor Department Of Bristol Siddeley Engines

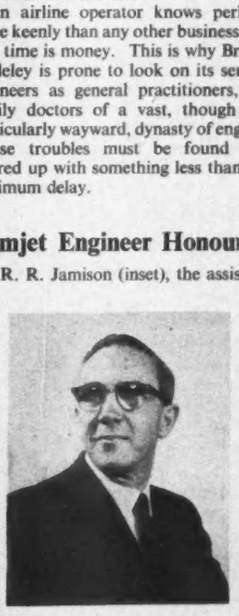
Just as important as the design and reliability of an aircraft engine is the provision of after-sales maintenance and spares by its manufacturer. Explaining the workings of their own service department, BRISTOL SIDDELEY ENGINES list among its responsibilities the Bristol Siddeley Proteus in the Britannias, and all the turbojets and turboprops in numbers of British and foreign military aircraft. In addition to these, the service department has to bear in mind the company's piston engines still serving in more than a dozen different types of operational aircraft.

When a service organisation has to be able to diagnose the trouble in engines of aircraft that may be at airports almost anywhere in the world, it is not surprising that it employs about 100 service engineers, operating from outposts spread from North America to Australia and Asia.

An airline operator knows perhaps more keenly than any other businessman that time is money. This is why Bristol Siddeley is prone to look on its service engineers as general practitioners, the family doctors of a vast, though not particularly wayward, dynasty of engines whose troubles must be found and cleared up with something less than the minimum delay.

Ramjet Engineer Honoured

Dr. R. R. Jamison (inset), the assistant



chief engineer and head of the ramjet department of Bristol Siddeley Engines, has been awarded the Enoch Thule bronze medal of the Swedish Society of Aeronautics.

The award was partly in recognition of Dr. Jamison's joint paper "Engines for the Supersonic Airliner", with Mr. R. J. Lane, given in Sweden, and partly to honour the work of the Bristol Siddeley ramjet team and the company achievements in supersonic propulsion work. Thule was a pioneer Swedish aircraft designer, manufacturer and flyer. He died in a flying accident in 1919.

Educated in South Africa, Dr. Jamison joined Rolls-Royce in 1937 and helped in the development of the Whittle jet. Joining Bristol in 1950, Dr. Jamison was responsible for the Thor ramjet and is a firm believer in ramjets for high speed manned aircraft.

Automatic Data Processing For Schools and Traffic

State and local government use of electronic computers in the United States will double over the next two years.

This estimate is published by the newsletter of AUTOMATIC DATA PROCESSING, a company of the American DIEBOLD group. The most important single change in the pattern forecast by ADP is a move away from the present predominance of computer equipment in state highway departments for engineering calculations with 80 per cent of the equipment going, over the next four years, to data processing and only 20 per cent to engineering uses.

ADP's survey discovered 131 electronic computer systems installed and in use by state, city and county governments. Four fifths of these were in use by state governments.

A wide variety of uses for the equipment was discovered. In New York the employment account records of 160,000 city employees are maintained and their salary checks made out.

Chicago is electronically memorising all traffic violations for the past ten years.

Texas has developed a system with the aid of a computer for keeping track of all the textbooks in circulation in a number of schools.

Evidently one of the developing uses of tabulating equipment and also of computers is the control of school records. It seems likely that quite soon even the children's report cards may be filled in by a computer.

The computer cannot eliminate the human error causing road accidents but by providing better analysis of information it is being used to find the answers that will lead to removing some of the hazards of the roads. The International Association of Chiefs of Police are developing a driver behaviour measurement system.

Installed in Wisconsin, this employs a series of pick-up points, photographic and speed measuring equipment and has its data processed by a computer. The information so collated is valuable for its light on congestion, accidents, traffic flow and performance.

Success of Precision Spring Firm

A company chairman who has had the cheering experience of announcing to his annual meeting that his forecast of the year before has more than been fulfilled is in a strong position.

Mr. F. S. Ratcliffe, chairman of the precision spring makers, RATCLIFFE'S SPRINGS, of Rochdale, is able not only to report that the year which he expected to produce better results has in fact seen the company's net profit rise by 50 per cent, but that the order book is full for many months to come.

New plant and machinery has been installed to meet the demand and it now seems likely that further machines will be ordered. The experimental and laboratory testing work carried out by the company has now reduced customer service failures to near vanishing point.

The Coles 'Argus' Mobile Crane

This is the fourth of the new Product Profiles appearing in ENGINEERING. It analyses the background and development of an unexpectedly sensitive machine.

A CERTAIN crude simplicity of design can often be as successful in engineering as elegant refinement. And in between the two extremes there is infinite scope for taste and judgment.

The Coles "Argus" crane boasts a refinement and sophistication of design that are unexpected in an item of plant which, one might think, need only be starkly functional. The lifting, moving and placing of loads can be done roughly and approximately, often without detriment to the load, but the designers of Coles cranes were early in foreseeing a growing demand for relatively precise machines, sensitive and responsive to the operator's requirements. In most branches of engineering today, the average value per unit weight of load is vastly greater than it was 20 or 30 years ago. More skill, more work, and more overheads are put into a hundredweight of aircraft engine than were put into a hundredweight of steam locomotive. It is easy to recognise this change now; the makers of Coles cranes were alive to it in the early stages.

Why, it might be asked, has the mobile crane only became common comparatively recently? The answer is in the genealogy of the crane. As early as the 18th century manually-worked "fixed" cranes, that is, cranes having the jib attached to a fixed centre post, and capable of rotation through an arc of a circle, were used in naval dockyards to lift cannon and other heavy items of equipment from shore to ship. One such 18th century crane in Malta was recently replaced by a new Coles crane. Ships' cranes and shore-based derrick cranes descended directly from these early examples.

With the industrial revolution and the coming of railways, cranes became a common sight in such places as goods yards where transhipment between horse cart and rail wagon was an everyday occurrence. Full-circle slewing became a common feature, but the cranes were still handworked and fixed to the ground.

The first movable cranes consisted simply of a small crane mounted on a railway wagon chassis, but self-propelled railway cranes using steam for power soon came into their own. Later it became customary to provide buffers on these, together with sufficient travelling power to enable a few wagons to be propelled at low speed. These were built in large numbers.

In 1879 a certain Mr. Henry J. Coles entered the field and established a small factory in Southwark, London. One of the first products was a locomotive steam crane of a pattern which was popular for many years and can still be found today, namely with a vertical boiler at the rear of the superstructure, and horizontal cylinders. A novelty was provided in the shape of a patent steam reversing mechanism. Thus the reputation Coles have established for always being in the forefront of technical development was evident at the outset.

Coles soon found that there was a big demand for such cranes and it was not long before they were being exported overseas. Then came the move to Derby, a Midlands town with a long tradition of engineering skill, the London premises having become too small for the firm's expansion. In 1913 Coles produced their first crane powered by an internal combustion engine. This was rail-mounted, similar to the steam and electric versions then in production.

Around the turn of the century some traction engine firms produced engines with a fixed jib and crane attachments at the front, for use on roads. These had severe limitations, the chief one being the inability to slew without moving the whole engine. The self-propelled mobile crane in the true sense, capable of operating on any reasonably level surface around the full 360°, did not come until 1920. In that year Coles produced the first mobile crane in Great Britain, and about the same time the first lorry-mounted or "truck-mounted" crane. Hence they were early pioneers of mobile crane development, having been inspired to some extent by wartime requirements which, at the time, could not be met.

Coles used petrol-electric drive for the first mobile cranes. A battery-electric model was also tried, without much success, but it shows that the firm were always ready to try something new. In 1928 the direct-drive diesel mobile crane was born, followed in 1930 by a railway version, so that by now the mobile crane had taken the lead in the firm's activities.

By 1937 both diesel-electric and petrol-electric mobile cranes were being produced, using the cantilever form of jib that has since become such

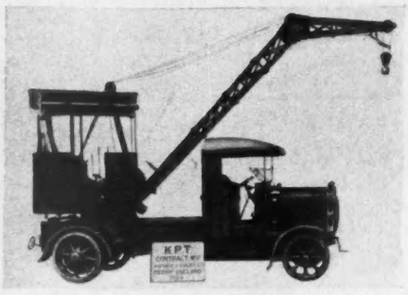


Fig. 1 Coles crane, 1923 vintage.

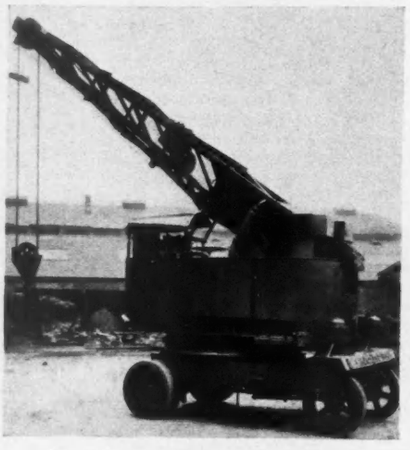
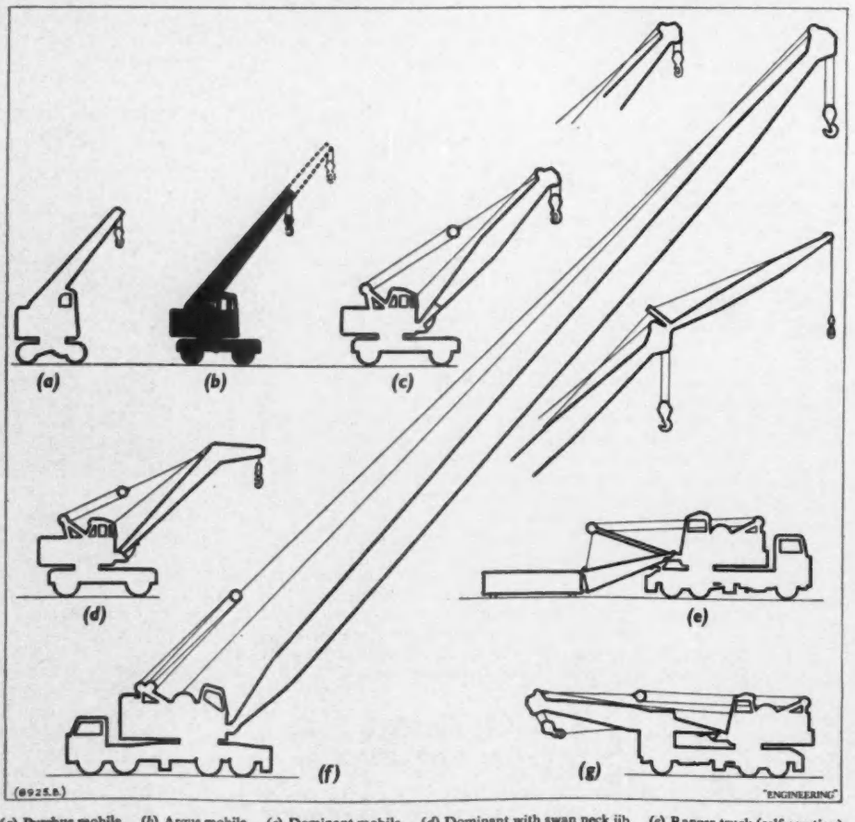


Fig. 2 Development by 1935.



(a) Pyrrhus mobile, (b) Argus mobile, (c) Dominant mobile, (d) Dominant with swan neck jib, (e) Ranger truck (self-erecting), (f) Conqueror truck (optional fly-extension), (g) Ranger truck (travelling order).

Fig. 3 Current range of Coles cranes.

a popular feature. The chief advantages of the cantilever jib are low headroom, permitting the crane to enter buildings and to operate under low ceilings, and an ability to handle bulkier loads with shorter jibs. Also in 1937 pressed steel wheels with pneumatic tyres were being fitted in place of the earlier cast steel wheels with solid tyres, resulting in a vastly improved sphere of action.

In 1939 the Derby works were duplicated by a new factory in Sunderland to meet the tremendous demand of the UK fighting services, which had adopted Coles products as standard. The experience of decades was compressed into a few years by the exigencies of war service, from which the Coles crane designs received the full benefit. The fruit was borne when hostilities ceased, for in 1945 Coles introduced a completely new range of cranes, including the well-known S 810, of which more are used than any other model. Shortly afterwards all crane production was concentrated at Sunderland, and Crown Works became almost entirely devoted to cranes. Extension of the works has become an almost continuous process and they now occupy 70 acres.

The demands of the post-war rebuilding programme, together with the greatly increased application of mechanical handling in industry generally, created a tremendous need for mobile cranes, and in turn intense competition between the various crane makers for this market. Mr. Arnold Hallsworth, managing director of Steels Engineering Products Limited, now proprietors of the Coles range, realised that this boom in the crane market could not be expected to last indefinitely, and that it would be followed by a period of reduced demand and even more intense competition. Accordingly, in 1958, a new range of Coles cranes emerged and thus the 6-ton Argus, successor to the S 810, was born. In the new range many significant improvements were incorporated. Already the Argus promises to exceed its predecessor in popularity. The Coles range now comprises mobile and truck-mounted cranes from 3 to 80 tons lifting capacity, and after a lapse of some years a return has been made to locomotive railway cranes.

Although during the formative years prior to 1939 mechanical, electric and hydraulic transmissions were all tried in conjunction with petrol or diesel engines, the design has now settled down to diesel-electric drive for all models. It was found to be generally superior, particularly from the point of view of performance and ease of operation. This concentration on one form of drive has enabled Steels to develop the machinery to a very fine degree, and the disadvantages sometimes associated with diesel electric transmission as opposed to the simpler hydraulic or mechanical forms have been eliminated.

Despite the well-known disadvantages of the steam engine, its characteristic of maximum torque at zero revs is especially suitable for a crane, the motions of which consist of a rapid succession of accelerations and decelerations. Variable-voltage diesel-electric drive as used in the Coles crane offers many of the advantages of steam without the attendant disadvantages. Precision of load placing, simplicity of the controls and the very small effort required on the part of the operator were found by ENGINEERING to be its most impressive features, and no special driving skill is called for.

The engine is direct coupled to a generator, arranged to supply current to separate motors controlling the various crane motions, i.e. hoisting, derricking, slewing or travelling. With the engine idling the generator output is negligible, and when at rest all the motions are locked by electromechanical brakes in series with the motors.

To start the crane working all the operator has to do is to select the motion required by means

Fig. 4 Giving the customer what he wants—greater refinement.

of a pilot switch controlled by a small lever on the panel in front of him; this will allow current to pass from the generator to the appropriate motor, via an interlocked pair of heavy duty reversing contactors. Foot pressure on the accelerator pedal will then cause the engine revolutions to increase and build up the generator output. At a predetermined point the current will be sufficient to release the brake and start the motor for whichever motion has been selected. Thereafter the speed of the motion can be controlled very accurately by means of the throttle pedal. Taking the foot off the pedal will, of course, allow the engine revolutions and generator output to drop until the brake again takes charge and stops the motion.

Since the torque build-up by the motors is gradual, a remarkable smoothness of operation is provided and the fine speed control permits extreme accuracy in the placing of loads. For this reason the Coles crane is particularly suitable for handling delicate and valuable equipment, and has found favour at airports all over the world for routine aircraft maintenance jobs, including that of changing over the engines. At London Airport, for example, the BOAC crane operators are specially trained in this work aims to make operation of the crane as nearly as possible foolproof and to safeguard the machine against abuse. The operator can select any motion irrespective of the engine speed at the time, and the equipment will then operate to initiate the required motion without shock to the electrical or mechanical parts. In other words, the crane adjusts itself to the work demanded of it without restricting the operator, thus permitting the optimum working cycle.

An important additional safety device is fitted as an optional extra. This is the safe load indicator which is operated automatically by a combination of the load on the hook and the angle of the jib. It not only gives audible and visual warning of overload, but also cuts the motion if the overload is allowed to continue. Automatic limit switches for positively preventing overtravel of hoist and derrick motions in both directions are fitted as standard.

The Argus has a Perkins Four 203 diesel engine or a Ford 592E at option. The generator and the four motors are all variable-voltage machines manufactured to BS 2613 class " E."

The generator is shunt wound, a special feature being the drooping characteristics of the output curves. The available voltage is a maximum under no-load conditions. As the demand from the motor for current increases, the voltage from the generator decreases, and thus both the motor and the generator are protected against excessive current flows, and fuses or other safety devices are unnecessary.

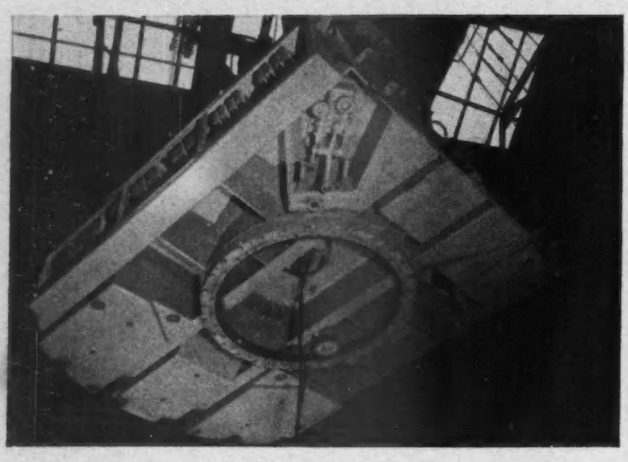


Fig. 5 (left) Superstructure from below showing slewing ring.

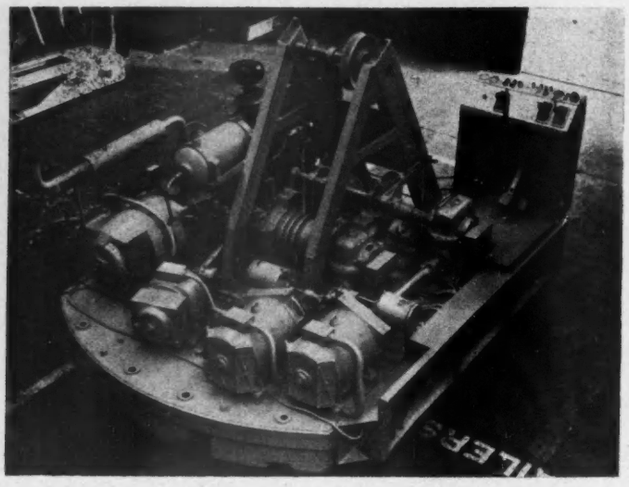


Fig. 6 (right) Superstructure machinery layout.

to satisfy insurance company requirements.

Improvements made in the 1958 range as exemplified in the Argus included increasing the size of the engine-generator combination to provide more power and to speed up the motions. The ample generator power available makes it possible for two motions—slewing and hoisting, for instance—to be performed simultaneously. Not more than two can be engaged, however, as each selector lever returns to the neutral position when released. This provides a measure of protection for the electric equipment against overloading. Normally all the motions are controlled by only three levers, placed sufficiently far apart and so clearly labelled that confusion between them is very unlikely.

Another strong point in favour of electrical transmission is the ability to build into the circuitry a comprehensive safety system for protection of both the operator and the machine. At one time a few diehards were reluctant to purchase a crane which had electrical drive, but that is an outmoded point of view. Steels have spared no effort to bring the electrical system to a high degree of reliability. At the same time they have ensured that those parts of the system most likely to require attention are grouped together in a readily-accessible position on the side of the superstructure. Special publicity has been given to the proved reliability of the system, and to the " fail-safe " characteristic of the electromechanical brakes.

The safety control system introduced in 1958

The most important purely mechanical improvement incorporated in the 1958 Argus was the substitution of a totally enclosed double ball-bearing slewing ring for the centre post and live roller ring. This gives a more even weight distribution over the crane chassis, reduces the power required to slew, eliminates maintenance and enables the ring to last the life of the crane.

The chassis of the Argus is based on a frame of steel sections electrically welded with a steel plate skin. The travel motor drives one of the axles through a single-speed worm gearbox and a differential. When running unladen a top speed of 4 m.p.h. is attainable, but four-wheel drive and faster travel are made available to meet special needs.

The steering axle has two wheels and is attached to the chassis by standard automobile laminated springs. Coles automatic reverse steering gear allows the chassis to be driven and steered normally irrespective of the slew angle of the superstructure. Air brakes act on all wheels and a hand parking brake is provided. A diesel-electric crane would be expected to cost more than an equivalent diesel-mechanical model. At one time the average cost of a Coles was appreciably greater than corresponding competitors and in 1958 special attention was given to production costs. The new range combined an increased use of welded fabrications with more expeditious shop methods. Although there have always been customers willing to pay more for a Coles crane by virtue of its high quality and long life, the difference in general price level compared with other makes is now considered to have been eliminated.

The performance of mobile cranes in the unblocked condition, i.e. without the use of outriggers, must always be limited. Obviously when blocked any crane will be able to cover a larger area at its maximum lifting capacity without danger of overturning, but with the loss of mobility with load. Thus one of the prime objects of the mobile crane is defeated. Steels have tackled this problem with vigour, and the result is that the Argus is not fitted with outriggers at all in the standard condition, although the S 810 was so fitted. This is due to several design improvements. Apart from keeping the centre of gravity low and within the roller race, the width has been increased, and continued cooperation from tyre manufacturers has led to the use of stabilised tread tyres which offer a splendid resistance to tilting when slewing with load.

The future of mobile cranes looks reasonably bright. The Coles Argus, backed by Steels' research and production resources, is certain to play a leading part in mechanical handling in many countries for some time to come. There are no signs that Steels are standing still. A full order book is the rule, and delivery times could still be shortened.

In the United Kingdom the Coles range is sold direct from the headquarters in London, with area offices at strategic points throughout the country. Overseas sales, except for those countries where Coles factories exist, are normally handled by agents and distributors, and these in turn are controlled from zone headquarters in London, New York and Basle. There are factories of the Steels Group building cranes in West Germany, USA, Australia and India.

The total labour force employed at Crown Works on crane production now numbers 2,000 and the steadier conditions of the crane market as compared with the neighbouring shipbuilding industry have enabled Steels to build up the right proportion of skilled and semi-skilled men.

Produce Depot Has Good Connections

The new depot in London for handling continental perishable produce should speed deliveries by up to 24 hours. Road and rail access to the depot is good.

A DEPOT to speed the handling of produce from the Continent has been built by the Southern Region, British Railways, next to the marshalling yard at Hither Green, London, at a cost of £1½ million. The produce—mainly fruit, flowers and vegetables from the Mediterranean—is taken from the depot by lorries or fast connecting train to markets throughout Britain. It is expected to cut up to 24 hours off the time it now takes to get the produce into the shops. A warehouse on the first floor of the depot can be used by traders wanting to avoid the congested central London markets.

Until now this traffic has been handled at Southwark depot, which has no warehouse accommodation and no siding facilities for stabling and sorting wagons. This meant that when the wagons had been unloaded they had to be sent to Bricklayers Arms for sorting, and that at peak periods some incoming wagons had

Fig. 1 Continental trucks are drawn into the new shed at Hither Green by electric locomotives equipped with pantographs.

to be stabled at stations along the route before going to Southwark or being diverted for unloading at Battersea Wharf, where extra staff had to be provided.

The new depot stands on the up side of the London-Dover main line, between Hither Green and Grove Park stations. Its site has the advantage of being next to Hither Green Marshalling Yard for interchange of traffic with other regions, on the direct route from the continent, outside the dense London traffic area, and close to the South Circular Road. Trains which have crossed the Channel by train ferry will be hauled to the depot by electric locomotives and shunted right into the main shed there. Mechanical handling equipment and on-the-spot customs clearance speed the transfer of the produce.

Said a Southern Region spokesman: "There is no doubt that this depot will make a huge difference to the quick handling of this highly perishable traffic, which is rapidly growing as more and more traders use our fast train ferry services. If traders take advantage of the excellent warehouse accommodation it could do a lot to relieve congestion in the markets. If they also use the rail links from Hither Green, it should mean that fewer traders will collect their consignments by lorries and this should help to relieve road congestion."

TWO LINES FOR UNLOADING

The depot has a goods shed about 1,000 ft long and 150 ft wide, composed of two unequal spans forming bays with 64 ft 7 in and 85 ft clear distance between columns. The smaller bay, nearest the main line, contains a rail siding with an unloading dock 3 ft 6 in above rail level and 50 ft wide. Minimum height above dock to beam is 14 ft 5 in. The larger span houses a covered roadway 70 ft wide and a further siding against the outer wall. The roadway is wide enough for lorries to load or unload wagons directly, and for other lorries to unload and load at the raised loading dock at the same time. Each siding can hold 25 to 30 Continental-type wagons. An external loading dock on the end of the depot will be used for loading produce from the warehouse direct into the lorries without them entering the shed.

Arrival and departure lines connecting with the main and local lines feed into six holding sidings and then into either of the shed sidings. To make shunting easier, these six holding or reception sidings and an engine release line are equipped with an overhead cable electric traction supply system for use by electric locomotives, which normally run on the third rail system but are also equipped with pantographs.

An additional storey has been constructed over two-thirds of the shed, at the London end. Half of it forms the warehouse and half has been left to allow for future development. The warehouse space contains a portion of 1,925 sq. yards partitioned off by means of fixed steel wire mesh on angle framing between circular steel columns, to serve as a customs bond. There are four lifts to carry produce from the loading dock to the warehouse. Offices and staff amenities are provided on the first floor for the agent and his staff and for the customs officers. At the London end of the shed adjacent to the small external loading dock are offices for clerks, police, and checkers.

About 150 railway staff and 10 customs staff will work at the depot, which at first is expected to handle about 200,000 tons of import traffic a year.

The shed is of reinforced concrete construction with walls of cavity brickwork. The heavy warehouse floor is supported by heavy two-span continuous reinforced concrete beams which were cast *in situ* by means of four gantries made up of Bailey bridging and military trestling, mounted on narrow gauge tracks, which supported the shuttering and reinforcement. These were jacked up as necessary to the correct level before the concrete was poured. After the concrete had set, the gantries were jacked down and moved progressively forward.

The roof covering throughout is of double asbestos-cement sheeting with an intervening 1 in layer of insulating material. Natural roof lighting is provided by 6 rows of continuous patent glazing with external foot walks for easy cleaning.

HANDLING EQUIPMENT

To handle some 2,000 pallets of 48 in by 40 in size, 18 Coventry Climax battery operated fork

Fig. 2 At the unloading dock, fork lift trucks transfer the perishable produce from truck to lorry for market distribution.

lift trucks have been supplied. They have a capacity of 18,000 lb and a speed of 5 m.p.h. when laden. The four electric-hydraulic goods lifts are 11 ft by 8 ft by 8 ft 9 in high, and big enough to allow two fork lift trucks to enter and off load their pallets at one time. The lifts were installed by Aldous and Campbell Limited and have a static capacity of 10 tons. Their carrying capacity is 4 tons and they operate at 75 ft per min.

There are also 10 Slingsby hand operated pallet trucks of 30 cwts capacity and 35 sets of gravity roller conveyors, each 8 ft long.

The shed itself is unheated. Ventilation, throughout is by means of air intake fans on both sides of the building, combined with extraction units in the roof. Cross ventilation is provided by the opening window sections. Hot cathode fluorescent lighting is used. The work was formulated under the general direction of Mr. A. H. Cantrell, chief civil engineer, Southern Region. The main contractors were Taylor Woodrow Construction Limited.

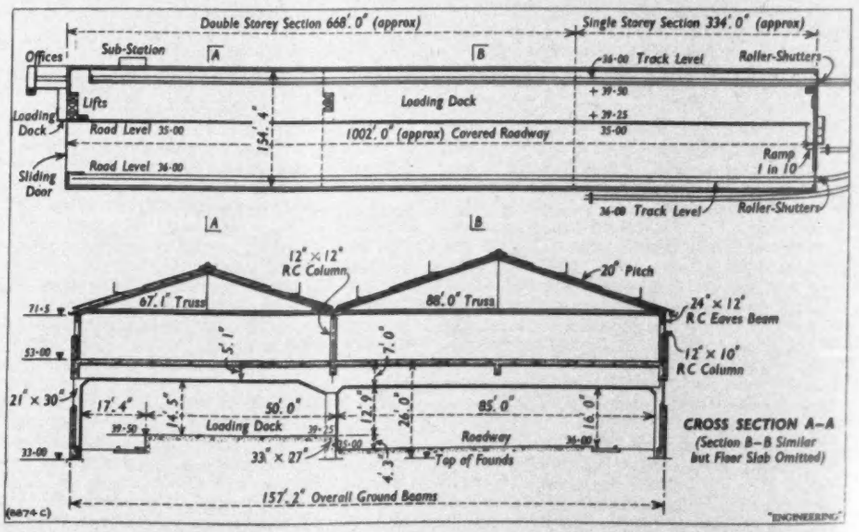


Fig. 3 The upper storey of the shed is used as a warehouse for traders who wish to avoid the congestion of central markets.

Carrying Out Contracts Under Water

Founded in 1946 by two ex-naval officers, Universal Divers Limited, of Liverpool, have become one of the leading British underwater contractors. Recent contracts include diving work on the North Pier foundations of the new Forth road bridge, a pipeline crossing of the River Tees, and survey work in the Straights of Dover for the Channel Tunnel Study Group.

Frogman gear is widely used on contracts where speed of arrival on site and economy of transport are essential, or where the great manoeuvrability of the frogman is an advantage —in sewers, for example, or even working upside down. The orthodox helmet-type dress, however, has not been superseded and is still essential for a wide range of diving contracts. A diver needs the extra protection of a helmet and high-pressure suit for working at depths much below 100 ft; while for handling materials that are either heavy or coarse, a diver prefers the protection offered by the heavy rubberised canvas of the orthodox suit. As this type of dress—with lead boots, brass helmet, and front and back weights—is considerably heavier than frogman gear, it is preferred by the diver who has to work in one spot in a strong current.

The range of operations an underwater contractor can be expected to be confronted with is wide. They may be asked to carry out underwater surveys to high precision in nil visibility; undertake any work involving the use of an oxy-arc cutter and welder; direct and control underwater block setting and concrete placement; carry out engineering work under water; undertake placement and detonation of explosives for sub-marine demolition; inspect and report on the condition of long culverts and tunnels; take underwater pictures or operate underwater television equipment.

An example of the progress of an underwater contract is provided by recent work carried out by Universal Divers for the United Kingdom Atomic Energy Authority. In summer, 1957, the company were engaged on drilling and blasting offshore rock near the fast fission breeder reactor at Dounreay. When this was completed they were commissioned by the Authority to carry out a survey at Warbarrow Bay, Dorset, in connection with the laying of a radioactive effluent outfall from the projected establishment at Winfrith Heath. This submarine survey was carried out during the autumn of 1957 by four divers under the supervision of one of the company directors.

The purpose of the survey was to locate precisely any reefs or irregularities in the sea bed that might disturb the curvature of the pipe line or hinder its laying. Using a locally-hired motor vessel, the divers established surveying equipment and made a detailed survey between the high water mark and a point some 4,000 yards to seaward. For future reference, marker buoys and concrete blocks were laid at intervals of 100 yards.

Among those asked to tender for the construction of the outfall, Taylor Woodrow Construction Limited engaged the services of Universal Divers during the summer of 1958 to take a further small survey and to carry out experimental rock drilling and blasting. During both this and the preliminary survey, self-contained frogman equipment was found to be of the utmost value, owing to its flexibility and ease of operation.

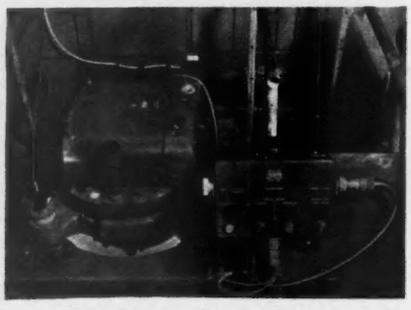
Following the acceptance of their tender, Taylor Woodrow again retained the services of Universal Divers to assist in the preparatory work involved in laying the outfall. Four divers were in constant employment, literally from dawn to dusk. They operated from a small fleet of vessels, including a landing craft supplied by Universal for transporting personnel and explosives. The charges were laid by divers in the standard helmet type dress, several tons of explosive frequently being detonated at once, and after many weeks of arduous and difficult work in extremely poor visibility a channel was blasted through obstructions of solid rock. A frogman of Universal Divers was loaned at this period to the engineers of the UKAEA to assist them in recording levels and accurately checking progress in this part of the contract. The final task completed by the company was the demolition of a sheet-steel piling cofferdam between high and low water. This was done with an oxy-arc underwater cutter.

Wide Angle Camera Speeds Aerial Photography

An aerial camera that can photograph an area of 593 sq. miles from a height of 50,000 ft in a single exposure on a negative 9 in square is to be used for photography in British Guiana. The weather conditions are so bad there, and opportunities for aerial photography so fleeting, that the camera's large coverage will be particularly useful.

The new camera is known as the Wild RC-9 Super Wide Angle camera and is of Swiss design and manufacture. Its lens has a focal length of 3·5 in. In British Guiana the flying height will be 15,000 ft. At that height a single exposure takes in 53 sq. miles, compared with 18 sq. miles by a standard camera.

The camera will be used by Fairey Air Surveys Limited, White Waltham, Berkshire, in a DC-3 fitted with long-range fuel tanks. This is the third consecutive year that the company has received a major contract for aerial photography in British Guiana. Because of the prevailing mist, rain, and low cloud, five radio stations are being set up in the interior of the country to report several times a day direct to the aircraft in flight, so that immediate advantage may be taken of any local patches of good weather.



The new wide angle camera mounted in the Dakota of Fairey Air Surveys. The box on the right controls the exposure rate.

Giesl Ejector Shows its Advantages

The improvement achieved in steam locomotive performance by fitting a Giesl ejector compared with replacing a single chimney by a double chimney can be estimated from the results of recent tests by British Railways on Class 9 2-10-0 locomotives. (The design and theoretical advantages of the Giesl ejector were described in a previous issue—ENGNG., p. 510, 17 April, '59.) It appears that the Giesl ejector reduced exhaust pressure by nearly four times the amount achieved by the double chimney. And whereas the ejector clearly improved locomotive performance, the variation produced by the double chimney was less than the difference between the performance of two locomotives of the same class.

The relevant figures on which this comparison is based are contained in Bulletin No. 13 and Report No. 18, and are as follows: With the single chimney, at a steam rate of 20,000 lb per hour, the draught at the front of the smokebox tube-plate was 4·0 in and the exhaust pressure was 4·5 lb per sq. in. The total vacuum was 5 in, including self-cleaning plates' resistance.

With the double chimney and a steaming rate of 20,000 lb per hour, the smokebox draught was 3·80 in and the exhaust pressure 3·80 lb per sq. in. In this locomotive no self-cleaning plates or spark arrester were fitted. Nor were they in the locomotive equipped with the ejector. This latter locomotive, for a steam rate of 20,000 lb per hour, showed a smokebox draught of 4·0 in and an exhaust pressure of 1·74 lb per sq. in. Thus the relation between the draughts at the front of the tube plates and the exhaust pressures was 0·89, 1·00, and 2·30 for the single chimney, the double chimney, and the Giesl ejector respectively.

When allowance is made for the fact that the single chimney had to overcome the additional resistance of the self-cleaning plates, the improvement made by the double chimney is clearly very small at this steam rate.

If the gas-steam relationship had been the same in all three cases, then the relative showing of the above draught/exhaust-pressure relations would be a direct measure of the relative pumping efficiencies. Allowing some advantage in steaming qualities for the double over the single chimney, and assuming that the ejector-equipped locomotive steamed only just as well as the double chimney engine, then the most favourable judgment for the double chimney would indicate comparative draughting efficiencies of 0·8 : 1·0 : 2·3.

Absolute figures for exhaust pressures show that the double chimney brought about a reduction of 0·7 lb per sq. in compared with the single chimney, while the Giesl ejector brought an additional reduction of 2·06 lb per sq. in; but it must be remembered that the draught produced by the double chimney was lower. Even disregarding this latter feature, the effect of the Giesl ejector upon exhaust pressure was 2·76/0·7, that is, 3·94 times as great as that of fitting a double chimney.

The figures for the double-chimney and the Giesl ejector were taken at the Rugby test plant. Those for the single chimney were first established by tests on the stationary test plant, the boiler efficiencies obtained being reproduced on the line later.

The Diverse Needs of Foreman Training

An important target of foreman, or surpervisor, training is to encourage the objective consideration and sharing of management problems and responsibilities.

IF THERE is one point of agreement on the difficult questions of the position and needs of foremen in industry, it is that specific training is increasingly necessary.

Fulfilling the foreman's role in a wide variety of firms may be found men who have graduated from famous universities all the way along the line to men whose knowledge has been picked up, in the words of the trade union leader and statesman Ernest Bevin, in " the hedgerows of experience."

There are many ways and places in which training in foremanship, or for supervisory positions, is given in the United Kingdom. They include technical colleges, a number of centres of adult education, and also certain special institutions, most of them with direct links with industry either through local firms or in some cases through an impressive list of major companies.

A useful classification has been established by the Brooklands County Technical College, in Surrey, who collaborate with a number of companies in arranging residential courses for supervisors.

The Brooklands courses are aimed at giving training for:

1 Those whose qualifications for control on shop floor or in office are that of long experience, character, and perhaps some internal training.

2 Those whose achievement in technical and professional fields has brought them to positions where the supervision of the work of others is their primary duty, and

3 Those who, for reasons given above, are becoming personally involved in coordinating their own decisions and attitudes with " opposite numbers " in other departments.

CONTROL

The courses, run at week ends since some firms find release for continuous study in working time is too difficult, have Control as their theme.

This is taken as covering the instruments of control available to managements and the place of the supervisor in a given scheme for control. Exercises, both written and spoken are done in meeting procedures and in communications.

The companies collaborating with the Brooklands County Technical College in these courses, three in number and running from the first in November and December up to the third in February and March, are:

Gresham Transformers, Hanworth
Grundy (Teddington)
Grundy Equipment, Cowley
Hackbridge Hewittic Electric, Walton-on-Thames
International Computers and Tabulators, Croydon
Partridge Transformers, Chessington
William Robertson, Warrington
Smith's Aircraft Instruments, Cheltenham
Solartron Electronic Group, Farnborough and Thames Ditton
Vickers Armstrongs (Aircraft), Weybridge
Vickers Armstrongs (Engineers), Crayford and Weymouth.

A swiftly growing specialist company giving supervisory training both in their own centre and at the works of a number of companies throughout the United Kingdom is the High Wycombe, Buckinghamshire, concern—Supervisory Training Services Limited. STS is able to call on its own staff of highly able lecturers and on university staff when the occasion arises.

Employers in Cardiff and Birmingham have asked STS to arrange courses locally and this will be done in accomodation found in the cities.

Supervisory training falls fairly easily into two divisions; courses given at a residential educational centre, and in-plant lectures and discussions where a group from one company gather in anything from a senior management dining room or company cinema to some iron walled room that happens to be spare at the time.

The residential course for supervisors puts its students alongside men from other plants and other industries. It genuinely offers a brief opportunity of wider horizons, broader prospects than a man works with in one company. It also provides continuous contact with the other supervisors on the course, with the instructors, and with an atmosphere of inquiry and objective consideration about the job.

MIXED BACKGROUNDS

In-plant training has its own special advantages too. Foremen, or supervisors, are not just units on an industrial payroll. They have wives, homes and other personal interests. The in-plant course does not incur resentment by breaking through these important elements in the supervisor's life. In some large establishments it is literally true that one foreman may not have met his opposite number in a distant department for years, or perhaps at all, and a series of afternoon lectures and discussion round the same table may not only achieve a useful gain in bringing the supervisor to think more effectively about his own and the management's problems, it may well enlarge to a useful degree the extent to which the management's front-line controllers do really know what they are all doing.

An in-plant lecture to airline supervisors.

What can be aimed at in a supervisor's course is well indicated by this description of a programme carried out by Supervisory Training Services for a major British airline operator. The three main stages were:—

1 An understanding of human behaviour in the industrial setting. Causes and effects of management policy, reorganisation and decisions.

2 The position of the Trade Union movement and the causes and effects of trade union behaviour, official and unofficial in the organisation and during a period of reorganisation.

3 Bearing in mind the above, a consideration of what management and supervisors can do to ensure the success of the enterprise. Such problems as communications, specialist functions, the status of the supervisor, and the understanding and use of management techniques (work study, etc.) are covered at this stage.

Over so broad a field the depth of penetration achieved in the inevitably short periods of instruction and discussions that are associated with supervisory training is understandably open to question. The answer, to be useful, must be related to the aim of the courses.

Plainly this must be to produce more efficient foremen—and within this it appears to be widely accepted is implicit the finer aim, to make the foreman think more naturally of management techniques, duties and objectives.

If the managing director of a company who had contracted for a supervisory training course for his foremen were to walk into the discussion and hear involved argument on the best way for a company to deal with a chief executive who turned out to be not up to his job, he might think that he had been mistaken in allowing the lecturer past the guard at the gate.

PROBLEMS

His impression could be reinforced when the argument turned to retirement of executives at fifty in order to stimulate promotion of younger men and the advance of new ideas in the company. But if he had any serious objection he would be told he was wrong.

For how else to encourage supervisors to think objectively about problems that come up in the running of the factory, if not by leading them into discussion.

As a contribution to the morale of a company's foremen the systematic course, whether at residential centre or in-plant has a widely recognised value. It is a commonplace that the way to catch a person's attention, and even regard, is to get him to talk about himself, and that includes his job. Evidently, and there is nothing particularly new about the principle of this, there is no means for improving the way a group of men do their job other than bringing them together in an organised, purposeful way, and leading them in discussion of their position in the company, the way in which they discharge their routine duties, the views they share, or do not share, on the way in which detailed, if hypothetical management problems are to be solved.

If it is not uncommon for some supervisors to approach an afternoon discussion group of an in-plant lecture as a " soft" way of passing away the time, it is much less common for such a group to disperse, probably a little after its due time, without having expended much more mental energy and force of argument than in a normal afternoon.

Among the Colleges and Centres at which foremen or supervisors' courses and experience of such training are available, are;

Ashridge,
Birmingham College of Technology,
Bristol College of Commerce,
Burton Manor College,
Cardiff, Welsh College of Advanced Technology,
Coventry Technical College,
Engineering and Allied Employers' West of England Association,
Glasgow, Royal College of Science and Technology,
Grantley Hall Residential College,
Hatfield Technical College,
Hendon Technical College,
Industrial Welfare Society,
Institute of Industrial Supervisors,
Leeds College of Commerce,
Leicester College of Technology and Commerce,
London, Regent Street, Polytechnic,
Manchester University, Holly Royde College,
Pendley Manor,
Wakefield Technical College,
Wolverhampton and Staffordshire College of Technology.

On the Shelf

By Frank H. Smith

MY HEART bleeds for the hon. librarian of the Juniors (Junior Institution of Engineers). In the editorial pages of the November *Journal* there is a complaint that each year when he takes stock of his 5,000 or so books some are missing. This is not entirely due to filching or unofficial borrowings but because people (in a spirit of misguided helpfulness) put back books that they have taken from the shelves instead of leaving the job to the authorised person. I know the trouble only too well. In fact, some users get quite snooty if you ask them not to, implying that they are as capable of putting a book back as any half-witted librarian and as they pursue this line of argument with the librarian they are putting back the book they are holding—on the wrong shelf. After telling readers not to replace books, the note goes on "That will relieve his brow of several furrows. Still more would disappear if he could learn the whereabouts of the following . . . (followed by titles of books)." I could not make out why the finding of certain titles should make others disappear until I realised that we were referring to the furrows on his brow.

Being a mean type I do not often give a boost to books which I have to buy for my library, but I am making an exception in the case of *Cassell's Directory of Publishing in Great Britain and the Commonwealth*. This is a first effort and costs 36*s*. It contains a quite extraordinary selection of material that one is always needing but can never find. The Ed.—Margaret Flower—is to be congratulated on filling the long felt and arranging it in an original fashion. Even the end plates are useful.

I have had a vient de paraître card from Editions Techniques des Industries de la Fonderie, 19 avenue Raphaël, Paris 16e, giving me the table of the matiéres of the new "Guide des Bureaux d'Etudes pour la Conception et le Trace des Piëces Moulées en Alliages Légers," for which they are asking 14 NF. Just the thing for those interested in the alliages legers which, are, of course, assez forts for the job en main.

From the American Chemical Society comes an announcement (I nearly forgot the address—1155 Sixteenth Street, NW Washington 6) of "a new way to get more from the chemical knowledge at hand," where they start with reference to chemical haystacks getting bigger and needles (which they omit to say are pieces of information) finer. Starting in 1961, *Journal of Chemical Documentation* will appear twice a year, "each issue containing a wealth of information by specialists in every phase of documentation." So now we have to phase up to documentation. They reckon on 50 articles a year and the cost is $10 ($7 to members).

I was not aware that the books of the Oxford University Press could be bought by monthly subscriptions until I read about it in their autumn list. And it is to mention their autumn list that I make such play with their subscription plan. Write to Book Subscription Department, OUP, Amen House, Warwick Square, London, EC4.

I get quite upset when somebody reads of something in my column and then finds he (or she) cannot get hold of it. I understand that my reference to *Transport Electronics News* led at least one person to ring British Transport Commission to ask for a copy, only to be told that it was for circulation among the staff of BTC. Yet I do not remember seeing "Restricted" on the cover and a copy certainly reached 36 Bedford Street. On behalf of my reader I feel hurt and I don't care if the BTC knows it. I can always use my bicycle.

I notice that Aslib are advertising for a librarian again. That job must be one of the finest springboards outside an Olympic swimming pool.

More Than Transparent

Glass: Its Industrial Applications. By CHARLES JOHN PHILLIPS. *Reinhold, New York; Chapman and Hall, London.* (56*s*)

As its title implies, this book is designed to give engineers, scientists and production personnel insight into what can be done with glass as an industrial material. To achieve this purpose, the book devotes the first six chapters to a comprehensive but at the same time concise recapitulation of the nature, manufacture and properties of glass. Much of this information has of course been published before, but here the author seems to have presented the subject most successfully and in sufficient technical detail to ensure ready appreciation of the significance of the later chapters which deal with applications. It is noteworthy also that reference is made to many of the most recent developments in glass technology.

C. J. Phillips is Professor of Ceramics at Rutgers University, New Brunswick, N.J., and has held positions in several of the larger glass companies and corporations in the United States. Consequently most of the data has particular reference to American practice. This emphasis does not however detract from the value of the book for British or other nationalities—the technology of glass is an international language.

Professor Phillips points out that in the glass industry quite unparalleled technical development has taken place in this century. This has made glass a really important industrial raw material which it is necessary for industrialists to know and understand. It is true to say that glass can combine simultaneously properties which no other single material can give.

Of particular value are the three chapters dealing with design and tolerances, nature and composition, and physical and chemical properties. These aspects are not well understood, as Professor Phillips notes, outside the industry, but here we have them presented in a clear and most readable manner.

The remainder of the book then proceeds to cover the multifarious industrial fields where glass plays a vital part. The first is of course in building construction, and covers general glazing and the various types of glass available for this purpose. There are sections on controlled light distribution, window insulation and fuel savings, a brief mention of modern curtain-wall construction and the use of colour fused tempered glass.

Then follow chapters on such widely varying products as glass containers, laboratory glassware, and glass for the chemical industry which includes plant-size glass pipelines, heat exchangers and columns.

There is a chapter on electric lamps and electron tubes followed in natural sequence by one on illumination, which covers not only indoor lighting but highway lighting, marine lighting, railway signalling and airport lighting.

The author then discusses optical glass. Here he considers glass for spectacles, microscopes, telescopes, cameras and an endless variety of instruments. Indeed without glass science would be blind.

To complete the survey there is a chapter devoted to special glasses and applications. The author discusses sintered glass, electrically conducting coatings, radiation sensitive glasses, tiny capacitors and resistors and huge radiation shielding windows weighing up to 10 tons. Without these "ponderous peepholes" of stabilised glass, radioactive research would be very handicapped.

Professor Phillips devotes the last chapter to "Fibrous Glass." In 23 pages manufacture, properties and applications are treated. Thermal insulation, both high and low temperature; filtration; acoustical insulation, textile products, electrical insulation and glass reinforced plastics are touched upon.

The book is provided with an interesting appendix defining a number of special terms relating to glass and glass products, and has also a satisfactory index. This is a most useful book which to a marked degree succeeds in doing what it sets out to do in a thorough, logical and readable fashion.

PETER M. DAVIDSON

Theory Follows Practice

Design and Performance of Gas Turbine Power Plants. Edited by W. R. HAWTHORNE and W. T. OLSON. High Speed Aerodynamics and Jet Propulsion, Volume II. *Princeton University Press, Princeton, N.J.; Oxford University Press, London.* (105*s*)

Turbulent Flows and Heat Transfer. Edited by C. C. LIN. High Speed Aerodynamics and Jet Propulsion. Volume 5. *Oxford University Press.* (105*s*)

The extent to which theoretical explanation lags behind experimental practice in gas dynamics is amply demonstrated by these two volumes. They are two further volumes in the 12 volume series on High Speed Aerodynamics and Jet Propulsion published jointly by the Oxford and Princeton University Presses. The title of the first is somewhat misleading for it is in fact concerned only with combustion systems and mechanical and metallurgical aspects of design, and for a complete study of gas-turbine power plants Volume 10 of the series, which is not yet published, is also required.

The book begins with a brief general introduction by one of the editors to the factors under consideration and then immediately moves on to the problems of combustion-chamber design. The requirements of a satisfactory combustion system for a gas turbine are dealt with, followed by a chapter on the techniques by which these requirements can be achieved. The third chapter in this section, entitled "Processes," deals with some theoretical aspects of the factors affecting combustion-chamber design. The connection between this work and the earlier, practical sections is often not quite clear. The attempt is apparently made to correlate the performance of complete combustion systems with the theoretical knowledge of the processes concerned, but the impression the reader receives is that the degree of correlation possible is very limited, and it seems that equally effective, or ineffective, correlations can be obtained from quite different theoretical bases.

A section then follows on experimental techniques which are relevant to the immense amount of research and development work which is being undertaken in connection with the development of gas-turbine combustion systems. A chapter reviewing the problems and requirements of fuel injection, covering the use of liquid, gaseous and solid fuels, shows this apparently menial work in its true importance, particularly by the quality of the research which has been done upon this topic.

There then follows a section on flame stabilisation which emphasises the largely empirical nature of any research which is to have an obvious connection with practical requirements. Theories to support the empirical findings are numerous, but it is difficult to find any conclusive evidence for the applicability of any one more than the others. In this chapter the various problems in flame stabilisation considered involve studies of gaseous mixtures of air/fuel-spray mixtures and stabilisation in actual combustion chambers.

It is shown in this latter connection that reaction-rate theory seems to apply better than

the others to the correlation of combustion performance, but the interesting point is made that a limit on combustion intensities is set more by the degree of mixing attained than by actual reaction rates, which suggests that theories based on this process are somewhat academic.

The mixing processes are seen from the foregoing chapters to be very important constituents of the total combustion process and a chapter follows on this important aspect of the work. Again we find as many theories as workers on the subject, all of which have only the most tenuous connections with practical problems.

A chapter on the requirements of fuels for gas turbines follows and the section on combustion concludes with a chapter on combustion-chamber development. This account confirms the belief that there is often little relation between much fundamental research and practical requirements, even when both are concerned with the same topic—combustion in this instance. For example, it is pointed out in this chapter that heat release rates of only 1/20th to 1/100th of the maximum possible in fully mixed reactors, on which much fundamental research has been done, is attained in practice.

The mechanical and metallurgical aspects of gas-turbine design are treated in the section which follows, and the introduction makes a very interesting point by noting how important to the study of materials generally the discovery of the X-ray diffraction method has been: and it is, of course, the material problems which largely decide the practicability of the gas turbine. This chapter deals mainly with the fundamental aspects of the mechanical properties of solids, and only surveys very briefly the properties of existing materials, for the very sound reason, made by the author of this chapter, that such a survey could only be very ephemeral. A final section of the book deals with the overall performance of turbine power plants. Ranging from a survey of the basic thermodynamics of the cycle to the problems of attaining satisfactory equilibrium running conditions, this chapter is very clearly presented and complicated only by the plethora of symbols which must be a printer's nightmare; for example, $_{s}\Delta T_{1s}^{o}$!

A similar comment was made when the present writer reviewed Volume 12 in this series (ENGNG., vol. 189, p. 762, 1960), and, following from this, it is impossible not to take note of the repetition and overlap which occurs in this series. This shortcoming is probably impossible to avoid, except perhaps with the very strictest editing, but it does make one wonder whether the value of such a comprehensive series of works as these volumes represent is really worth the enormous effort which must have been involved.

The second volume, *Turbulent Flows and Heat Transfer*, considers interrelated problems of turbulent flow and heat transfer which are, of course, of immense importance in the subject matter of these volumes, and, indeed, in many modern technologies. It begins with an authoritative section on the factors affecting the transition from laminar to turbulent flow. The complexity of theoretical processes associated with this problem are made amply clear, and the fact that apparently trivial factors can effect transition suggests that it is unlikely that a complete and comprehensive theory will ever be produced.

A section follows which propounds the fundamental theories which may be applied to the calculation of velocity, pressure and temperature gradients in turbulent flow, and the necessity for semi-empirical methods is made clear both in this chapter and, in a rather different manner, in that following which deals with statistical theories of turbulence. Conduction of heat is treated in a short chapter of very conventional form, and the following chapter on convection in liquids and gases is similarly representative of much well known work, with the emphasis on compressible flow in gases as befits a book of this nature. This latter section is very exhaustive, and ranges from a survey of boiling heat transfer to the problems of transpiration cooling, in which the coolant is forced through a porous boundary. The volume concludes with a chapter which contains very familiar and standard work on heat transfer by radiation, presented, in the words of the preface, " from somewhat different points of view."

This final chapter with the so-appropriate remarks in the preface is characteristic of the nature of the work presented in these volumes, and presumably of much work that is being done in the development of high-speed aerodynamics. It is characteristic in the sense that it illustrates the two quite distinct streams of thinking and research which exist. The first comprises those concerned with the fundamental aspects of the problems which are involved, and the second those concerned with the more practical day-to-day engineering requirements which necessitate a sound estimate of the probable values of many coefficients required for the purposes of design.

What seems clear from reading these volumes is the gap which exists between these two streams. It is at its most evident in the work on combustion in the earlier volume and in the theoretical work on turbulent flow, and it only occasionally seems to be bridged where the fundamentalist predicts trends before the empiricist discovers them experimentally. An example of this is in the prediction of the stabilising effect of heat transfer on the boundary layer, particularly in compressible flow; but unfortunately such examples are rare and the theoretician is usually struggling behind the empiricist to explain the results which are already being used for engineering design. It is certain that the rate of technical progress would increase enormously if the gap between the theoretical and experimenta streams could be bridged more often.

F. J. BAYLEY

Exclude Contaminating Gases

Vacuum Processing in Metalworking. By J. WESLEY CABLE. *Reinhold, New York; Chapman and Hall, London.* (44*s*)

During recent years a number of books, and papers in the technical press have covered the theoretical side of vacuum metalworking. These have left a gap for a practical treatment of the subject aimed at the newcomer to vacuum work and the non-scientific reader. In his book the author has endeavoured to fill this gap; indeed in the opening chapters covering the history and principals of vacuum techniques he does this admirably. The text is simple and easily understood by the non-scientific but there is also enough information to keep the more advanced reader interested. In later chapters it is disappointing to find that far too much space is spent on the non-vacuum aspect of metalworking.

The processes in general use, outgassing refining, purification and distillation, are dealt with briefly but adequately, as are vacuum sintering, vacuum deposition, brazing, and welding. Vacuum melting and casting receive a more thorough treatment, but it is unfortunate that the most rapidly expanding process in this field, vacuum degassing of steel, receives only a paragraph.

Illustrations are few and unrelated to the text, and it is felt that in a book of this type a few simple line diagrams would have helped to make the text much simpler to understand.

The book is equipped with a comprehensive index and is well worth reading provided it is understood that it is not intended as a work of reference but only as an introduction to the subject. Bearing in mind the purpose of the book, it is a pity that the author, after recommending the reader to consult other works for more technical details, neglects to provide a list of references. However, the publishers to some extent compensate for this omission by announcements on the dust cover.

G. M. GILL

Dear or Deadly Octopus?

Corporation Wife. By CATHERINE GASKIN. *Collins.* (16*s*)

During one-third of every 24 hours men and women are forced into certain social patterns in order to earn a living. It is surprising how small a part the novel has played in helping the present highly articulate generation to understand the problems created by this situation.

In these days it is accepted that the efforts of companies to give security and satisfactory remuneration to employees may lead to commercial juggernauts capable of destroying individual freedom and imposing false values. The effect may be felt, not only by employees but also by their families. So far has this encroachment on privacy proceeded in the name of managerial paternalism that a trend in thinking has developed which emphasises the function of companies to earn profits and to tinker less with private lives under the cloak of reasonable demands for loyalty. All this is raw material for the technique of the novel and Miss Gaskin has set out to deal with it.

Her book is the story of an American corporation which buys up a small and declining company in a country town not far from New York and saves the local economy from gradual attrition. The price to be paid is conformity to the moral standards and social interests of the corporation —not all of which are brutally self-centred. Miss Gaskin is commendably fair on this point. The book tells of how the corporation's needs, interests and standards percolate into the private lives of the community.

Such a theme is a tremendously important one for this age. It is the stuff of tragedy, or tragi-comedy. It calls for the gradual overwhelming of a hero or the antics of Mr. Charles Chaplin at executive level. The narrative of this book is exceedingly well handled but it does not live up to its great possibilities.

The story is developed through the experiences of the wives of the corporation's executives, who are either local people or have been brought in from New York to help run the new subsidiary. The telling of the story through the social by-play is exceedingly well done. The book is thus written from a woman's point of view and could be all the more refreshing for that. There is no reason why the theme should not have a tragic heroine in the shape of an executive's wife. To men who read it the issues could be made all the more alive.

The opportunity is lost however. The narrative moves quickly in a crisp, readable, woman's magazine style. Its flavour is cynical. There are plenty of emotional tears but none of true

anguish or laughter. It all lacks humour and at times sensitivity. The corporation, big and forbidding, stays in the background and comes alive only on its publicity side. The fact that men find satisfaction in their work is there, but not the flavour of it. The men are typed and shadowy. They come alive only for incidents of sexual passion. The women are sexually casual and in a book which has some exceedingly subtle touches, this is the big unsubtle mistake. The average male reader has strong romantic, though at times concealed, prejudices and in the end he really does not care what happens to these unhappy emotional women. The author nearly swings it the right way by having a girl raped, the most vivid character in the book, but even here we get the wrong twist in the end.

The book is about freedom. How is one to maintain one's individuality at all levels against the organised pressure to conform? In the end some of the characters get freedom of a kind, but most succumb. The reader expects them to do so, for each enters the story ill-equipped for the fight. None of them have any religious or philosophical resources to fall back on; none of them believe in anything bigger than themselves. They seek, and temporarily find, solace in sex or the bottle. The theme is worth bigger people and more completely rounded characters. The book is saying, perhaps unconsciously, that freedom can be preserved only by the eternal vigilance of men and women of character.

In many ways, however, it is a good try. The story does not flag and there are some excellent touches. The fear of younger men's initiative felt by senior executives, the calculated shrewdness of top management making terms with its collective social conscience, the agonies of a small business in decline, men intriguing and calling it work—they are all woven in. It is a stimulating, readable but at times exasperating book. G. E. TEWSON

New Books

Trade Union Law. By NORMAN ARTHUR CITRINE. 2nd Edition. *Stevens and Sons Limited.* (105*s*)

In the ten years since the first edition of this "authoritative exposition" (Lord Kilmuir) some important legislative changes have been made, and decisions of the courts have affected every aspect of trade union law. The author has sought to cater for the layman —the trade union officer and the student—as well as the lawyer.

The Development of the English Traction Engine. By RONALD H. CLARK. *Goose and Son Limited, 10 Davey Place, Norwich.* (84*s*)

Mr. Clark deplores the popular pre-eminence of the showman's engine at rallies, and apostrophises the absent tandem compounds, the early chain and box ackshaft engines. His compendium of the history of this noble machine contains nearly 600 illustrations, ranging from an elevation of Hancock's Tug to a fascinating group of views of Aveling's, Burrell's, Fowler's and Savage's erecting shops.

Propulsion Systems for Space Flight. By WILLIAM R. CORLISS. *McGraw-Hill, New York and London.* (77*s* 6*d*)

A detailed survey of all the important propulsion concepts for flight beyond the atmosphere. Systems such as the nuclear rocket, ion drives, photon drives and anti-gravity devices are compared for performance capability, technical feasibility and present state of development.

Accidents and Ill-Health at Work. By JOHN L. WILLIAMS. *Staples Press.* (45*s*)

The problems of accident prevention in all forms of work, and the efficacy of methods in current use are discussed, and the empirical development of the existing scheme criticised. A comparison is made with international practice and an account given of recent improvements and proposals for advances.

Introduction to Modern Network Synthesis. By M. E. VAN VALKENBURG. *Wiley, New York and London.* (94*s*)

Writing at the graduate or advanced undergraduate level, the author has attempted to hold a course between the approach of applied mathematics and the solving of day-to-day problems, and at the same time limit the number of subjects covered so that from the vast literature enough detail for understanding could be provided for each topic.

BP Book of Motor Cycle Racing. Edited by MURRAY WALKER. *Stanley Paul.* (8*s* 6*d*)

A heavily-illustrated account of the history, riders, makers, models, records and circuits. For the enthusiast.

Selling: Its Broader Dimensions. By TAYLOR W. MELOAN and JOHN M. RATHMELL. *Macmillan, New York and London.* (38*s* 6*d*)

A collection of readings intended to supplement the content of organised courses in salesmanship, drawn from a very wide selection of books and journals.

Servomechanisms. By P. L. TAYLOR. *Longmans.* (42*s*)

This is an introductory textbook of closed-loop automatic control systems. It presupposes no knowledge of the subject, and is suitable for use in the final year of National Certificate, Diploma of Technology, and degree courses.

The Testing of Electrical Machines. By LAURENCE H. A. CARR. *Macdonald.* (50*s*)

Primarily intended for the use of test staff, this is a book which will be of interest to inspecting engineers, junior design staff, and to teaching staff concerned with the subject. In addition to test techniques the author has considered the principles of the standard classes of machines, the purposes of the tests, and the treatment of the data obtained.

Watermills with Horizontal Wheels. By PAUL N. WILSON. *Society for the Protection of Ancient Buildings, 55 Great Ormond Street, London, WC1.* (6*s*)

The horizontal wheels in their simplest forms were essentially tools of primitive agricultural communities, unlike the vertical wheel, which even in the Middle Ages was the prime-mover utilised by an evolving capitalist society.

Self-Organizing Systems: Proceedings of an Interdisciplinary Conference, May, 1959. Edited by MARSHALL C. YOVITS and SCOTT CAMERON. *Pergamon Press.* (60*s*)

During the last decade or so there have been great advances in information processing techniques. However, certain problems, mostly those involving non-numerical types of information, can be solved efficiently only by the use of a machine with a high degree of learning or self-organising capacity. The conference reported here was sponsored by the US Office of Naval Research and the Armour Research Foundation.

Principes des Calculatrices Numériques Automatiques. By P. NASLIN. 2nd edition. *Dunod, 92 rue Bonaparte, Paris 6.* (13 *NFr*)

Based on courses given at the École National Supérieure de l'Armement and the École Nationale de l'Electricite, this introduction to computers is divided into sections on operation and electronics.

Steel. By FREDERICK E. DEAN. *Frederick Muller.* (9*s* 6*d*)

A young person's guide to the history, manufacture and utilisation of steel, published in the *Mechanical Age Library*.

Mineral Processing. By E. J. PRYOR. 2nd edition of "An Introduction to Mineral Dressing. *Mining Publications Limited, Salisbury House, London, EC2.* (90*s*)

The change of title in this new edition reflects the development of scope which has taken place, and, while the introductory matter has been retained, the main subjects are developed to a more advanced level.

The Life and Works of A. K. Erlang. By E. BROCKMEYER, H. L. HALSTRØM and ARNE JENSEN. 2nd edition. Acta Polytechnica Scandinavica, Applied Mathematics and Computing Machinery Series No. 6. *Acta Polytechnica Scandinavica, Box 5073, Stockholm 5.* (21 *Sw. Kr.*)

This volume was intended as a complete edition of A. K. Erlang's principal works, which had previously been available in articles distributed through the Danish and foreign periodical literature. It comprises a biographical essay, and surveys of Mr. Erlang's statistical, mathematical and electrotechnical works.

Public Relations and Management. By DAVID FINN. *Reinhold, New York; Chapman and Hall, London,* (36*s*)

Written for the business executive, this book sets out to show what public relations can and cannot do for a company. The author describes how public relations fit into management policy, and demonstrates how a campaign works and how it can be controlled and appraised.

Hydro-Electric Power. By ERNEST F. CARTER. *Frederick Muller.* (9*s* 6*d*)

In this book for younger readers the author traces the story of water power from ancient China to some of the major hydro-electric schemes of the last decade. A volume in the *Mechanical Age Library*.

The Reviewers

Mr. Peter M. Davidson is manager of the technical sales department of Pilkington Brothers Limited.

Dr. F. J. Bayley, M.Sc., A.M.I.Mech.E., is reader in gas dynamics in the University of Durham.

Mr. G. M. Gill, A.Met. (Sheff.), L.I.M., is a scientific officer in the Metal Treatment Section of the Metallurgy (General) Division of the British Iron and Steel Research Association.

Mr. G. E. Tewson, M.A., is a partner in the firm O. W. Roskill Industrial Consultants.

Trade Publications

Copies of any of the following trade publications are obtainable from the addresses given, though distribution is sometimes restricted.

Materials

Incoloy DS. HENRY WIGGIN AND CO. LTD., Wiggin Street, Birmingham 16. This Ni-Cr-iron alloy was known as Nimonic DS. Data and notes on fabrication. 7 pp., ill.

Aluminium Scrap. ASSOCIATION OF LIGHT ALLOY REFINERS AND SMELTERS LTD., 3 Albemarle Street, London, W1. If you produce any kind of aluminium scrap obtain this. It will tell you what you should separate from what to obtain a fair price with least trouble. Index to trade language. 3 pp., unill.

Greases. ACHESON COLLOIDS LTD., P.O. Box 12, Plymouth, Devon. A list of Gredag greases and special compounds. Data for preliminary selection. 13 pp., unill.

Aluminium Alloys. IMPERIAL ALUMINIUM CO. LTD., P.O. Box 216, Birmingham 6. This company's complete index to properties of their alloys. 70 pp. unill.

Dry Chemical Feeds. WALLACE AND TIERNAN LTD. Power Road, London, W4. Large table shows dry chemicals commonly used in water, sewage and waste treatment and gives data to aid selection. 3 pp., unill.

Nickel Alloy Steels. MOND NICKEL CO. LTD., Thames House, Millbank, London, SW1. Collection of informative Mond advertisements on En steels.

Lead for Batteries. LEAD DEVELOPMENT ASSOCIATION, 18 Adam Street, London, WC2. Up to date introduction to workings of the lead acid battery. 4 pp., ill.

Ready-Mixed Concrete. CEMENT AND CONCRETE ASSOCIATION, 52 Grosvenor Gardens, London, SW1. List of UK suppliers revised to August, 1960. 37 pp., unill.

Electrical Insulation. MICANITE AND INSULATORS CO. LTD., Blackhouse Lane, Walthamstow, London, E17. Revised data on company's range of glass based materials. 25 pp., ill.

High Impact Polystyrene Sheet. SARO PRODUCTS LTD., East Cowes, Isle of Wight. Wealth of experience on making best use of polystyrene sheet. Forming techniques. 28 pp., ill.

Packings and Jointings. GEORGE ANGUS AND CO. LTD., Westgate Road, Newcastle upon Tyne 1. Commendable catalogue of this firm's products, giving data for selection. 38 pp., ill.

Refractory Coating for Steelmakers. CORROSION LTD., Southampton. $\frac{1}{8}$ in thick coating of Furnascote on ganister bricks has increased their life. 1 p. plus data, unill.

Marketing

Electric Motor Controls For Moscow Trade Fair

AMONG the products of the ALLEN WEST Company (the electric motor control gear manufacturers of Brighton) which are to be shown next year at the British Trade Fair in Moscow are a flameproof direct switching starter, pushbutton stations and a shunt limit switch, examples of equipment used in oil refineries and in mining plant in addition to their application in the chemical industry.

With their brochure prepared for the Trade Fair and printed in Russian, Allen West will have a 500 sq. ft stand in the central building. The stand designer, Mr. John Lansdell, was responsible for the general design of a number of British overseas trade fairs, including those at Copenhagen, Helsinki and Lisbon.

Among the 621 exhibitors whose stands will cover products from shoes and textiles to heavy machinery, Allen West will be the sole exhibitor concentrating exclusively on electrical control gear.

Worswick-Baggeler Manufacturing Agreement

Equipment providing the only automatic process available in the production of non-ferrous ingots is covered by an agreement concluded between ALAN WORSWICK (ENGINEERING) Limited, the engineers and consultants of Blackburn, Lancashire, and MESSRS. H. J. BAGGELER, of Cologne, West Germany.

The agreement enabling Worswick to produce Baggeler equipment under licence is for the range of melting, holding and annealing furnaces, ingot casting machines, automatic slab or ingot stackers and molten metal metering pumps for transferring the metal to moulds from the furnace in accurate quantities.

Anglo-Romanian Trading Arrangements

The trade agreement signed earlier this month between Britain and Romania provides quotas for the purchase by the Romanians of £4¼ million worth of UK made plant, machinery, chemicals, textiles, motor cars and miscellaneous products in the first period, which ends on 30 September next year, For the same period quota lists are provided for British purchases of Romanian goods worth £3¾ million. This is an additional amount to those goods which can be imported into Britain from Romania and other countries without import licences.

Parallel with the trade agreement, negotiations over British claims arising from, or presented under the Peace Treaty with Romania, and claims arising from Romanian nationalisation measures, were concluded with an agreement.

Claims by oil companies were excluded from the agreement and these the Romanian Government have agreed to negotiate on in 1966.

The agreement, signed in London, provides for payment by the Romanian Government of £1,250,000 in full and final settlement. Details of the distribution of the money are to be announced later. The Romanians have agreed to complete the payments by 31 January, 1967.

BBC Orders Thirty EMI Transmitters

Thirty 1 kW VHF modulated ransmitter amplifiers by ELECTRIC AND MUSICAL INSTRUMENTS ELECTRONICS have been ordered by the BRITISH BROADCASTING CORPORATION. They are to be used for extended coverage and to give interference-free reception in a number of congested areas where reception is now unsatisfactory.

The amplifiers will be installed in five satellite transmitting stations, each equipped with six amplifiers. They will radiate the Home, Light and Third Programmes from two transmitters working in parallel on the same frequency.

This arrangement allows the stations to be used without an operator in constant attendance and means that programmes will continue even if one amplifier should fail. Similar EMI equipment has been supplied to the BBC for VHF/FM stations in Anglesey and the Orkneys.

On the export front, EMI Electronics has received an order from the Mexican television centre, TELEVICENTRO, for three complete television camera channels. The units, delivered as soon as the order was finally agreed, replace equipment of United States origin.

EMI equipment for television in Mexico is now added to the long export list, which includes Canada, the United States, Norway, Poland, Italy, Switzerland, Hungary, Australia and China.

Jaguar Car Assembly In South Africa

An agreement has been concluded between JAGUAR CARS and a Durban, South Africa, firm for the assembly in the Union of certain Jaguar cars. A pilot scheme has already been begun and the transition to full production, aiming at a target of several thousand cars a year is to start shortly.

The cars will be shipped to Durban, knocked-down and will be assembled and distributed from there throughout South Africa.

Ceylon Orders 439 Buses from Leyland

Against active competition from Germany and Japan the LEYLAND MOTORS commercial vehicle company has won a £750,000 order from the CEYLON TRANSPORT BOARD. More than 400 buses will be sent to Ceylon under the contract, bringing the number of Leyland buses in use in Ceylon to almost 1,400.

In its three year life the Ceylon Transport Board has bought £1 million worth of Leyland buses. Following through their connection with the busy Lancashire vehicle company, the Transport Board have ordered a number of Leyland diesel engines to replace the original engines of other makes of vehicle.

All the buses ordered are to be pquipped with 5-speed gearboxes, single-eeed rear axles and power boosted hydraulic brakes. The CTB chairman has flown to England to discuss engineering and supply questions with Leyland executives.

Cuba Seeking Barter Trade With Britain and Canada

Cuba is hoping to establish a consortium for reciprocal trade with western countries, and especially with Britain and Canada.

The director of the BANCO PARA EL COMERCIO EXTERIOR DE CUBA, Dr. Jacinto Torres, has said in Havana that Cuba is in a position to consider a trade agreement with the United Kingdom similar to that she now has with the Soviet Union. Under Cuba's agreement with the Russians she is paid twenty per cent in dollars for her sugar and the remaining eighty per cent is to be spent of Cuban purchases in the Soviet Union.

There are at the moment a number of limited agreements with British firms and the Cuban authorities think of these as reciprocal agreements rather than as barter deals.

Cuba is said to be not without dollars to pay for some of her trade but in Dr. Torres description—" the greater part of our trade is based on a compensating mechanism."

Advance of the Aluminium Cylinder Block in America

The replacement of the cast iron cylinder block in motor cars by die cast aluminium cylinder blocks was forecast by Mr. A. F. Bauer, chief engineer and assistant general manager of the DOEHLER JARVIS DIVISION of the NATIONAL LEAD Company, of Toledo, USA, at a recent technical session of the National Die Casting Congress, held appropriately enough in the Detroit Artillery Armoury.

The congress is sponsored by the Society of Die Casting Engineers, which has its headquarters in Detroit.

Mr. Bauer referred to the use of aluminium lightweight parts and of magnesium in European rear-engined cars. American engineering practice, tending towards aluminium die cast blocks for front engined cars was, said Mr. Bauer, far in advance of current European developments.

His example was the die cast aluminium block of which Doehler Jarvis have produced 50,000 for the Rambler compact car, a product of AMERICAN MOTORS. Other aluminium die cast blocks are being used in Buick, Oldsmobile and Pontiac cars and one is being developed for Chrysler.

The block for the Rambler is six cylindered. As long ago as 1951 the Doehler Jarvis company successfully produced a die cast aluminium four cylinder block but this was never put into production.

Small Industrialists Club To Stimulate Export Efforts

Some fifty leaders of small businesses in the North West have formed together into an Export Club in order to further their effectiveness in selling overseas.

The suggestion for the club came from Mr. R. S. Redmond, chairman of the Liverpool District of the Federation of British Industries. The Board of Trade might not agree with Mr. Redmond when he says—" No organisation or government can build up an individual company's sales." He is, however, on firmer ground when he points to the help that comparing ideas and pooling experience can give.

Chemicals and Oil Boost for Industrial Ulster

With the announcements that IMPERIAL CHEMICAL INDUSTRIES and BRITISH PETROLEUM are to build major plants in Northern Ireland, beginning work next year, another important step has been taken towards ending the economic difficulties of one of the most difficult of the United Kingdom's areas of high unemployment.

ICI have bought 200 acres at Kilroot, Co. Antrim, where a factory will be built for the production of Terylene and possibly other synthetic fibres.

Across Belfast Lough, between Belfast and Holywood, Co. Down, BP are to construct an £8 million oil refinery intended to serve consumers in Western Europe as well as in Great Britain

The ICI Kilroot plant is expected to come into production during 1963. It will need a labour force of around 700 men for its construction. The labour force, when production is in full swing, will be about 1,150. If the output of synthetic fibres goes according to plan this figure should increase to not less than 2,000.

There is a possibility that the Kilroot plant will also be used for the manufacture of staple fibres, filament yarns and textile mono-filaments from polypropylene under the agreement with Montecatini, of Milan, Italy. The initial production under this agreement is to be at Wilton.

Middle East Grade

Work on the BP refinery is to start early next year and it should be completed in two years. The capacity of the plant will be 1,300,000 tons of crude oil a year and it is to produce petrol, kerosine, aviation turbine fuels, light and heavy diesel oils, fuel oil and liquefied petroleum gas. Designed to handle crude oil from Middle East sources the refinery's oil will be brought in tankers of up to 32,000 tons. The jetty to be built in Belfast Lough will cost £500,000.

Lord Chandos, chairman of the Northern Ireland Development Council, has commented: " In the face of this evidence, who can doubt that Northern Ireland is our up-and-coming area for development in the United Kingdom."

Australian Trading Deficit Rising Steeply

Great Britain is not the only country whose trading position is getting worse In the first four months of the current financial year Australia has accumulated a deficit in her overseas trade of £11.2 million. This is a sharp reversal of the results for the same period of the last financial year when there was a £4 million profit.

October's trade deficit for Australia was the eighth in succession.

Producing and Testing Bellows Joints

In use, the bellows joint undergoes wide variations of temperature and stress. This necessitates exhaustive testing of both product and materials during manufacture.

BELLOWS fabrication is one of the more recent industrial developments, the nature of which demands considerable research into processes and materials followed by exhaustive testing of both the end product and the materials used in it. In the Chesser tube works of Munro and Miller Limited at Sighthill, Edinburgh, strong emphasis is laid upon these aspects in the production of a wide range of bellows.

The bellows joint consists primarily of a length of corrugated tube, the corrugations being termed convolutions. These convolutions may be mounted in a number of ways according to the duty being performed. A simple axial bellows has, for example, flanges at each end of the convolutions and is secured simply to the adjoining pipe work. In other forms, the bellows may be gimbal mounted or may be provided with hinged restraints in order to absorb internal pressure loading. A particularly impressive form is the articulated bellows developed for duties such as in tanker loading lines, these consisting of two sets of convolutions, separated by a length of tube and restrained by axial restraints.

The main use for bellows is in pipe layouts for accommodating linear thermal expansion and contraction. They have many advantages over loops and sliding glands for this duty. As compared with loops, bellows joints accommodate greater movement and required fewer fittings and suports due to their greater simplicity. In addition, this simplicity gives them superior flow characteristics. While sliding glands can accept a greater amount of axial movement than bellows joints, the latter can accommodate lateral and other out of balance movements and in addition, provide a packless, leaktight joint.

VIBRATION ABSORPTION

The absorption of vibration is also an important function of these units and in this connection they are widely employed with engine exhaust systems in addition to their more common use in power stations, chemical factories, steel plants, distilleries, refineries and production units of all kinds where pipework is used under conditions of varying temperature.

The application has a considerable effect upon the design of the bellows, some instances requiring closely convoluted units as, for example, in the range of "Bellex" joints produced to absorb high frequency vibrations in diesel exhaust pipings while in others, such as those used to accommodate thermal expansion in tanker cargo pumping lines, the number of convolutions per foot is relatively small. Further design complications arise from the materials in which the bellows are fabricated.

While the more standard type bellows are fabricated in various types of stainless steel and are welded to mild steel flanges, where corrosion is a particular consideration fabrication may be in "Monel" metal. Bellows in this material have been supplied for many uses, one pipe layout handling oil refinery products using 74 bellows in Monel, ranging in size from 20 in to 48 in in diameter and accommodating 12 in of movement with operating conditions in the range 40° to 170° F at 100 lb per sq. in. Elsewhere, in the chemical industry, 60 in diameter Monel bellows are used to carry steam containing salts in solution at pressures between 10 lb per sq. in and high vacuum while standard bellows in 8 in diameter manufactured in 12 gauge stainless steel are currently produced for pressures of up to 240 lb per sq. in at 20° C. Where higher temperatures and pressures are encountered and where considerable movement has to be accommodated, equalising rings are fitted to the bellows, these rings having the same contour as the convolutions when fully compressed. The function of the rings is to limit the amount of compression on any one convolution to a certain maximum figure and to transfer the thrust to succeeding convolutions.

In certain cases where, for example, fluids containing solids are being piped, a sleeve may be fitted to prevent solids accumulating in the convolutions. Sleeves are also fitted where minimum resistance to gas flow is important.

In the development of these bellows and of suitable manufacturing methods, considerable research was entailed, both with regard to the development of suitable materials and to the heat treatment of these. A programme of experimental and theoretical stressing was carried out in conjunction with the Heriot-Watt College.

MANUFACTURE

The sequence of manufacture starts with the selection of the required gauge of sheet to form the necessary diameter. This is cut to size, rolled and longitudinally seam welded with an argon arc automatic welding machine. The resulting tube is then inspected, blanked off, and the convolutions are introduced hydraulically. A feature of this method is the fact that the thinning effect in the convolutions is negligible. By means of heat treatment before and after forming, the maximum ductility is maintained and the process itself exerts a uniformly rising pressure, resulting in a steady plastic flow of the material.

Although automatic welding is used wherever possible in the joining of the convolutions, flanges and other bellows components, much hand welding is necessary, especially where the convolutions have been fabricated in stainless steel while the flanges are of mild steel. In such cases hand welding is carried out using Cooper and Turner Diadem Zircon HR2 electrodes, the chemical composition of these electrodes providing a barrier which overcomes the tendency of carbon to migrate from one steel to another and to precipitate as a non metallic boundary on the edge of a weld under these conditions. Other electrodes of the same make are used for different steels. The weld is made in a single pass and, although the welds are subject to radiography, no metallurgical failure has been experienced with this electrode during the past four years.

GRINDING AND POLISHING

Post weld treatment includes the grinding and polishing of welded surfaces with Consolidated Pneumatic Hicycle high frequency electric grinders. The models used are CP type 5180 straight grinders and 511AG angle grinders, these being operated from a 12 kVA frequency changer. These tools, by virtue of their high and constant spindle speeds, have been found particularly suitable for weld dressing on the many different steels used in the fabrication of the bellows units. The constant high speed characteristic of the tool is due to the fact that it operates from a 200 cycle supply and uses a squirrel cage induction motor embodying a solid copper bar rotor running at 1,200 r.p.m. This construction, while giving the optimum conditions for grinding, eliminates the possibility of burnt out motors and also gives an inherently high degree of safety in operation, the operating voltage to earth being only 72V as compared with 220/250V with a universal tool. For some requirements, as for example, those of the nuclear power industry, semi-clean conditioning is carried out with grinders fitted with "Gem" stainless steel brushes. After further inspection, the bellows are treated with "trilac" to remove any final traces of foreign matter and are sealed in polyethylene bags.

The bellows are subjected to hydraulic and radiographic tests, these being available to the inspecting authorities before acceptance. The radiographic section is equipped with a labora-

(Left) A grinder fitted with a stainless steel wire brush being used to clean a non-equalising bellows unit.

(Right) Welding a stainless steel bellows to a mild steel flange.

Concluding
Bellows Joints

tory in which are housed a caesium source and a Fedrex 150 kV gas insulated set, together with developing and illuminated viewing facilities. A mobile Pantak 150 kV set is also available. This latter unit uses a Villard rectified circuit, the tube rating being 100 kV at 10 mA, 140 kV at 8 mA, and 150 kV at 6 mA. The focal spot is 2·3mm by 2·3mm and the tube is water cooled from a pump unit mounted on the carrying trolley. To overcome any mains current fluctuations which may occur, the control unit has a compensator which operates on variations in the supply between 200 and 250V, this being particularly important in view of the consistently high standard of results which are required. The controls of the tube current and voltage are of the stepless type in this unit and the voltage is indicated on hermetically sealed meters, a compensating device allowing for the effect of the various tube currents and thus eliminating the need for a calibration chart. Exposures are terminated automatically by a synchronous timer.

A typical example of the radiography carried out is the examination of a bellows of Cr—Mo—steel, welded to 1½ in thick mild steel flanges. For this examination the caesium source is employed, the exposure time being 12 hours and the source film distance being 18 in. The film used is Kodak M ultra fine grain film to obtain the highest possible sensitivity. At one end of the bellows, the thickness was 1½ in and here lead screens were employed, these being omitted on the other 1 in weld. The perfection of a development technique to suit these conditions where the same grade film is used for one exposure of two welds of differing thicknesses has been particularly successful.

This exposure time of 12 hours is convenient for overnight shots, but where quicker results are necessary, lead screens are employed throughout and the developing time is varied accordingly.

Hydro-Pneumatic Machine Tool Control

A background in hydraulic control systems for guided missiles has helped an American firm to develop a fresh approach to machine tool automation which totally discards the use of electronics—the *bête noire* of so many production engineers.

A design based upon hydro-pneumatic principles has enabled Moog Servocontrols Inc. of E. Aurora, New York, to produce a tape reading numerical control system which is reported to cost between one half and one third of the price of a comparable electronic device.

The Moog system comprises a combined tape reader and control console, a compressed air storage compartment, and a hydraulically operated piston and cylinder beneath the machine table which derives its power from a source within the machine itself.

A machine table with the two pistons which control its position.

In operation, the punched tape is placed in the tape reader which translates the hole pattern into air pressures that act upon a metal diaphragm transducer. The transducer converts air pressure into fluid power and this in turn acts on a series of cylinder ports. Varying fluid pressures operate servo and power pistons which position the machine table on two axes for any positional metalworking process such as drilling, boring, tapping and reaming. The system also controls all other machine functions including turret indexing and coolant operation.

The substitution of pneumatic and hydraulic components for electronics leads to several other advantages as well as the lower initial cost. The first of these is the greater durability of control system components and the consequent reduction of down time. The second point, the manufacturer claims, is that the new system at least equals the precision of electronic systems without the danger of gradually introduced inaccuracies due to component wear. The guaranteed repeatability of the Moog system is ±0·0003 in. The tolerance on table positioning is claimed to be ±0·0005 in.

Ease of maintenance is another attraction. In everyday use, the entire system can be maintained by the average plant engineer, without the lengthy training required to repair most electronic units.

Selective Overhead Conveyors

An electronically controlled overhead conveyor system has been developed by Webb Conveyors and Automation Limited, a member of the Elliott-Automation Group. It is said that the system opens up entirely new possibilities in the realm of mechanical handling.

The system permits the use of standard overhead conveyor without any of the special mechanical attachments which are normally associated with other types of selective handling equipment. It applies electronic control techniques, developed by the Elliott-Automation Group over the past ten years, to mechanical handling problems and can be adapted to deal with virtually any number of pick-up points and delivery stations.

A typical system now in the course of manufacture involves 30 machines, each of which must be fed with any one of 70 different raw materials. On long runs, some machines use the same material for weeks while others change their material every few hours. The flexibility of this particular system is such that feed variations of this nature can be carried out in less than two minutes by a single operator at a central control console.

The 30 machines in use are fed with raw material from overhead chain conveyor, carrying fifty 100 lb capacity, bottom emptying buckets at a speed of 30 ft per min. The conveyor passes under pneumatically operated gates, which control the discharge of materials from the 70 one ton bunkers, and over the machines in a continuous circuit. Each machine has its own hopper, fitted with a minimum level indicator. Pneumatically operated ramps, mounted over the machine hoppers, are raised automatically to engage buckets carrying material called for by that machine. The contents are emptied into the hopper and the bucket completes the conveyor circuit before being blown and wiped clean automatically. This particular installation handles 6 tons of material in an hour—a figure which can very simply be increased threefold if required.

An illustration of the method of operation is as follows: number 27 machine, on a continuous run, consumes material to a preset minimum quantity. This results in a signal being sent to the control console, where it is held pending the arrival of an empty bucket at the appropriate bunker. Discharge is initiated by the console as soon as an empty bucket arrives, and the appropriate material is then conveyed to the machine which has asked for it.

An important point to note is that the operator can change the material feed of any machine during normal shift working without affecting any of the other machines. The procedure simply involves changing a plug from one socket to another, while the control centre goes on monitoring the supply of material to all 30 machines.

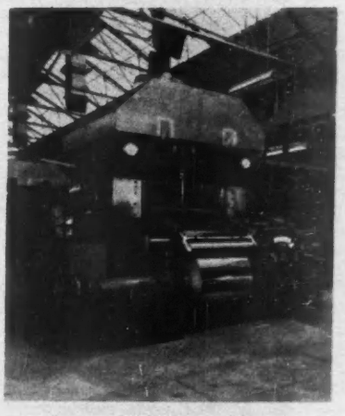
A system of visual indication is provided for the operator's guidance and shows what machines are calling for materials and what materials are in process of transit.

Making More Aluminium Foil

Venesta Foils Limited, whose Silvertown and Glasgow factories already account for more than one third of the country's aluminium foil output, have made a further increase in production capacity. Two new rolling mills brought into operation last month will boost output of the Silvertown factory by a quarter.

The two new mills will produce primarily the lighter gauge foils, thinner than 0·018 mm, used in the packaging field. They have been planned to fit exactly into the factory's existing rolling scheme to produce a 50 per cent increase in the company's capacity for this type of foil. Both are four-high and are designed to roll foil up to 30 in wide. They were built by W. H. A. Robertson and Company Limited of Bedford.

Modern systems for control of quality and economy are incorporated in the mills, including radioisotope scanning units which give a continuous check on foil thickness during rolling.



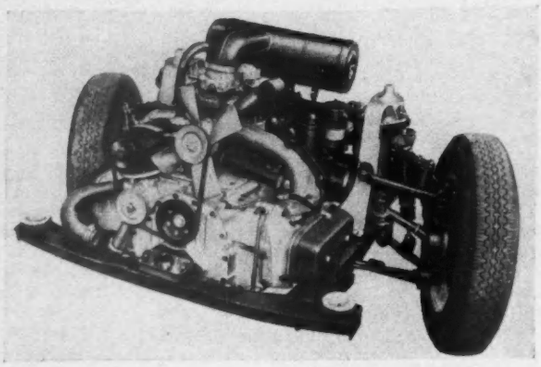
One of the new four-high rolling mills.

The mills are served by equally new ancillary equipment. Two opening machines are designed to produce reels of finished foil up to 18 in in diameter—containing more than four times the weight and length of foil than could previously be offered by Venesta in single reels. For foil converters and users, this means longer non-stop runs on printing and packaging machinery, and savings in operating time.

Erratum

We regret that an error arose in the article "Making Service Equipment More Reliable" (ENGNG., 11 Nov. '60, pp. 662-3). Both the bottom line of the diagram, Fig. 1, and the second sentence of its accompanying caption should have read as follows: The apparent safety margin *minus* the true safety margin *equals* the margin of ignorance.

Considerable attention has been paid to robust construction and quiet running, although this has been at the expense of the car's power-to-weight ratio.



The 1·5 litre engine is a water-cooled flat four, placed ahead of the front wheel centres

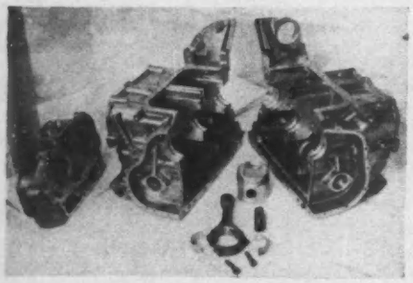
Front Wheel Drive for New Lancia Car

For the first time, an Italian firm has built a production car with front wheel drive. Its break from Lancia tradition indicates the determination behind that company's expansionist policy.

By Gordon Wilkins

THE LANCIA FLAVIA car announced at the Turin Motor Show is the first design for which Prof. Fessia, the company's present chief engineer, has been fully responsible. It breaks away from traditional Lancia principles, being Italy's first production car with front wheel drive. Its basic layout recalls that of the Cemsa Caproni prototype for which Fessia was responsible shortly after the war, before he went to the Fiat German subsidiary at Heilbronn. It will be the main weapon in the expansionist policy initiated by Sig. Pesenti, the cement and oil magnate who is now a majority shareholder. Bodies will eventually be pressed, assembled, painted and trimmed at the big new plant now under construction at Chivasso outside Turin.

The engine is a water-cooled flat four (82 × 71 mm 1,498 c.c.) hung ahead of the front wheel centres. With a compression ratio of 8·3 to 1 it operates on normal grade fuel and gives 78 b.h.p. nett at 5,200 r.p.m. with maximum torque of 81·5 lb-ft at the farily high figure of 3,500 r.p.m. The engines is formed of two main pressure die castings, each consisting of two cylinders and half the sump and crankcase which are split on the vertical centre line. These castings, produced in collaboration with Injecta SA, the Swiss specialists, are made to very fine limits, some of the wall thicknesses being only 0·118 in. Cylinders have wet liners of centrifugally cast chromium iron. Throughout the design of the car there are signs that technical quality has taken precedence over considerations of weight and cost. The cylinders are widely spaced to allow room for a robust crankshaft in three large bearings of 2·375 in diameter with widths varying from 0·9 to 1·375 in. Vandervell supplies the indium-lead-copper bearing shells for main and big end bearings. The cylinder heads are of light alloy with inserted cast iron valve seats and hemispherical combustion chambers. The valves lie parallel to the centre line of the engine, at an included angle of 39°. To keep down the length of the pushrods, there are two camshafts, chain drive, and the valve location requires an individual spindle for each rocker. A single twin-choke downdraught carburettor, made by Solex or Weber, stands on a light alloy manifold with water-heated hotspot. Pump, fan and dynamo are belt driven, the fan pulley lying between the fan and the radiator. The cooling system includes a thermostat and radiator shutters adjustable from the driving seat.



The engine is formed of two main pressure die castings, each consisting of two cylinders and half the sump and crankcase.

The single-plate clutch is by Fichtel and Sachs with a flexible centre designed by Lancia. The gearbox, behind the differential, has four forward speeds, all with synchromesh. Input and output are at the same point but top gear is direct. This is obtained as on the Renault light commercial vehicle gearbox by taking the drive through a quill shaft (in this case passing through the final drive hypoid pinion) and through to the end of the hollow main shaft of the gearbox, on which are the constant mesh pinions for the other three speeds. Gearbox and final drive casing are also pressure die cast and split on the centre line. The hypoid pinion is offset upwards to raise the crankshaft centre line and increase ground clearance.

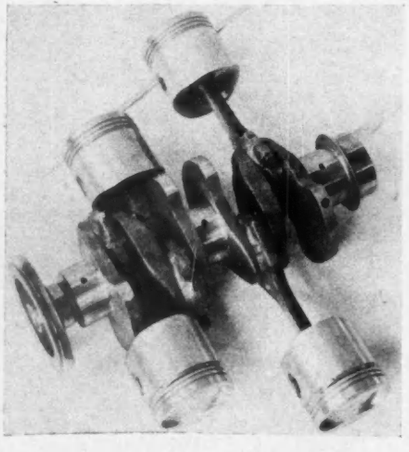
Birfield supply the drive shafts, with Rzeppa constant velocity universal joints at each end, the inner joints being mounted on balls and grooves to provide low-friction length adjustment as the wheels rise and fall. Suspension is by a transverse leaf spring (it would have been difficult to find room for coils) bearing on the upper wishbone of each pair through a thick rubber pad. Shock absorbers are de Carbon telescopic, which incorporates a cushion of trapped air.

Engine, transmission, front suspension and steering (by Gemmer worm and roller) are all mounted on a sub frame insulated from the main steel body structure by six rubber mountings.

The rear axle tube is carried on two half elliptic springs, with their front ends in rubber-mounted trunnions and rubber-bushed shackles at the rear. By extensive use of rubber bushes and sealed bearings, points requiring regular chassis greasing have been kept down to five on the steering linkage. Brakes are Dunlop discs, self adjusting, with vacuum servo and tandem master cylinders giving separate circuits for front and rear. Springs have plastic inserts between the leaves.

To prevent snow chains fouling the wheel valances when they are fitted to the front wheels, a lever on the steering box brings auxiliary lock stops into play, increasing the turning circle from 36 ft 2 in to 39 ft.

The body is practically a six seater, and unusually large for a 1½ litre car. Maximum interior width is obtained by using curved glass for side windows, which drop in curved guides.



The flat four arrangement of the pistons. To keep down length of pushrods, there are two camshafts and a chain drive.

The doors are thus unusually slim. Those at the front have red warning lights in their edges, illuminated as soon as they are opened. Equipment is complete and well thought out. Instruments include tachometer and a ribbon type speedometer. Warning lamps cover fuel reserve, choke or handbrake on, water temperature, low oil pressure, headlamp main beam and parking lamps.

Robust construction and elaborate attention to elimination of noise and vibration have raised the kerb weight to 2,690 lb which is certainly not light for a 1½ litre car, but use of a larger engine was precluded by the Italian taxation system.

Unbalanced and Initially Bent Shafts

An elementary explanation is given of the difference between balancing a shaft suffering from lack of mass balance, and balancing one which is initially bent.

By Professor R. E. D. Bishop, M.A., Ph.D., D.Sc.(Eng.), A.M.I.Mech.E.

Department of Mechanical Engineering, University College, London

THE whirling of an unbalanced shaft was first explained rationally by Jeffcott.[1] He tackled the problem by assuming the shaft to be massless, with a central, offset, massive particle (or disc) attached to it. In this way he produced a qualitative "picture" of the motion. Jeffcott adopted this rather violent idealisation because of the difficulty of the problem—a difficulty which has caused his simple analysis to be widely reproduced in text-books. Despite this widespread reproduction of his analysis, one object of this article is to elaborate on one or two aspects of Jeffcott's theory; for their treatment does not appear to have been altogether above reproach.

It has, in fact, proved possible to relax Jeffcott's idealisation[2 3 4] though the result of doing so hardly seems suitable material for elementary text-books on vibration. In the process of relaxing the idealisation, two problems have been considered, one being that of an unbalanced shaft and the other that of an initially bent shaft. Experiments on actual shafts have focused attention upon the difference between these two cases and emphasised the importance of the latter.[5] Since this is not dealt with by Jeffcott, and since his elementary treatment is undeniably effective for teaching purposes, it seems worthwhile to show what modification his analysis needs if it is to cover initial lack of straightness in the shaft, i.e. "elastic unbalance" (as opposed to want of mass balance). In the interests of simplicity, only the steady forced motions will be considered here.

Notation

- b Viscous damping coefficient.
- e Offset causing mass unbalance.
- k Flexural stiffness at mid-point of shaft span.
- m Mass of shaft.
- r Amplitude of whirling vibration.
- ϵ Offset representing initial bend (or elastic unbalance).
- ζ Phase lag of deflection behind plane of unbalance.
- μ Dimensionless measure of damping $(= b/2m\omega_1)$
- Ω Rotational speed of shaft.
- ω_1 $= \sqrt{(k/m)}$.

For the meanings of α, β, ρ see the figures.

UNBALANCED SHAFT

Consider a light simply-supported uniform shaft rotating with constant angular speed Ω. The mass of the shaft is supposed to reside in a particle of mass m which is off-set from the shaft axis by an amount e. Fig. 1 shows an instantaneous view of the forces acting on a thin slice of the shaft at mid span; O represents the intersection of the line of the bearings with the transverse plane at mid span, C is the intersection of the bent shaft axis with that plane, while the three forces acting are:—

Centrifugal inertia force, $m\rho\Omega^2$,
Viscous damping force, $br\Omega$,
Spring force due to shaft stiffness, kr.

These three forces are not concurrent so that they are not in equilibrium. It can easily be shown, however, that equilibrium will prevail if a torque of magnitude $br^2\Omega$ is applied to the slice as shown in Fig. 1. Of the four tractions shown in Fig. 1, two—the force kr and the couple $br^2\Omega$—are supplied by the shaft. The conditions of equilibrium of the light shaft (without its attached mass) show that the force kr must be supplied at the bearings while the couple $br^2\Omega$ represents the torque needed to drive the shaft in its frictional environment.

For equilibrium of the central slice shown in Fig. 1, along and perpendicular to OC, it is necessary that

$$\left.\begin{aligned} m\rho\Omega^2\cos\alpha - kr &= 0 \\ m\rho\Omega^2\sin\alpha - br\Omega &= 0 \end{aligned}\right\} \quad . \quad (1)$$

and, from the geometry of the configuration it is seen that

$$\left.\begin{aligned} \rho\sin\alpha &= e\sin\zeta \\ \rho\cos\alpha &= r + e\cos\zeta \end{aligned}\right\} \quad . \quad (2)$$

These equations, between them, lead to the results

$$\tan\zeta = \frac{b\Omega}{k - m\Omega^2} = \frac{2\mu\Omega\omega_1}{\omega_1^2 - \Omega^2} \quad . \quad (3)$$

$$r = \frac{m\Omega^2 e}{\sqrt{[(k - m\Omega^2)^2 + b^2\Omega^2]}} = \frac{e\Omega^2}{\sqrt{[(\omega_1^2 - \Omega^2)^2 + 4\mu^2\Omega^2\omega_1^2]}} \quad (4)$$

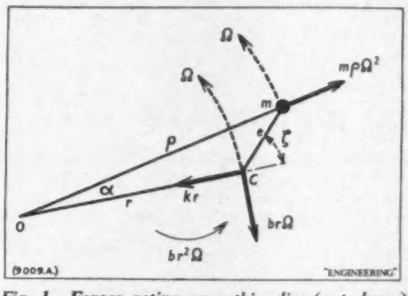


Fig. 1 Forces acting on a thin slice (not shown) of the light shaft at the section at which the offset mass is supposed to be placed.

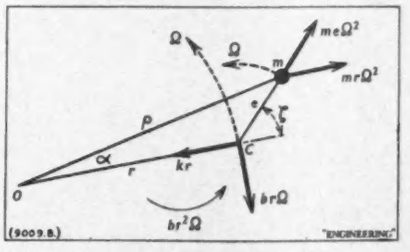


Fig. 2 Alternative representation of system of forces shown in Fig. 1.

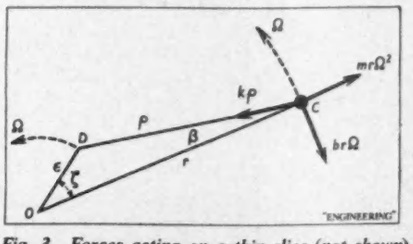


Fig. 3 Forces acting on a thin slice (not shown) of the initially bent light shaft at the section where the mass is supposed to reside.

The interpretation of equations (3) and (4) is too well known to require repetition here.[6]

There is an alternative, equivalent method of visualising the motion (which is in fact the one adopted by Jeffcott). According to this the shaft rotates about its own axis, through C, with angular velocity Ω; in addition, the shaft axis rotates about the bearing axis O (while the shaft itself translates) with angular velocity ω $(= \Omega$ for forced motion). This is illustrated in Fig. 2 where the appropriate forces on the slice are indicated. Once more, equilibrium can only exist if a torque of magnitude $br^2\Omega$ acts as shown. The results (3) and (4) may easily be obtained from this figure and there is now a slight advantage in that the displacement can be more easily seen to lag behind a "driving force," namely $me\Omega^2$, by the angle ζ. Moreover, it must be remembered that Jeffcott's adoption of this point of view enabled him to *find* the motion—in the previous analysis (of Fig. 1) this has to be known beforehand.

INITIALLY BENT SHAFT

Suppose now that the shaft does not suffer from mass unbalance, but is initially bent. The massive particle is placed at C and the restoring force acts towards a point D which represents the intersection of the bent (though otherwise undeflected) axis of the shaft with the transverse plane at mid span. This is indicated in Fig. 3 where OD represents the deflection at mid-span when $\Omega = 0$, due to initial bend.

If equilibrium of the central slice is to prevail in the directions along and perpendicular to OC then

$$\left.\begin{aligned} m r\Omega^2 - k\rho\cos\beta &= 0 \\ br\Omega - k\rho\sin\beta &= 0 \end{aligned}\right\} \quad . \quad (5)$$

From the geometry of the figure it is seen that

$$\left.\begin{aligned} \rho\sin\beta &= \epsilon\sin\zeta \\ r &= \rho\cos\beta + \epsilon\cos\zeta \end{aligned}\right\} \quad . \quad (6)$$

Equations (5) and (6) now give

$$\tan\zeta = \frac{b\Omega}{k - m\Omega^2} = \frac{2\mu\Omega\omega_1}{\omega_1^2 - \Omega^2} \quad . \quad (7)$$

as before, and

$$r = \frac{k\epsilon}{\sqrt{[(k - m\Omega^2)^2 + b^2\Omega^2]}} = \frac{\epsilon\omega_1^2}{\sqrt{[(\omega_1^2 - \Omega^2)^2 + 4\mu^2\Omega^2\omega_1^2]}} \quad . \quad (8)$$

This value of r differs from that found previously only in the appearance of ω_1^2 in the numerator in place of Ω^2. Since these are both constants, the physical interpretation of the result remains the same, but only for a fixed value of Ω.

An alternative representation of the motion, comparable with that of Fig. 2, is again available. By this, the shaft rotates about its own axis C with angular velocity Ω while C rotates about O with angular velocity ω $(= \Omega$ for forced motion).

The reader may well be left wondering why there is no torque shown in Fig. 3; for it is clear that a torque (presumably of magnitude $br^2\Omega$) must be applied to the shaft in order that the viscous friction may be overcome. The force exerted upon the central slice by the shaft is of magnitude $k\rho$ and it does not pass through the line of bearings O. For equilibrium of the massless shaft (without its attached mass), this force must be balanced at the bearings by a parallel force $k\rho$ acting through O together with a couple of magnitude

$$L = k\rho r\sin\beta = kr\epsilon\sin\zeta = br^2\Omega \quad . \quad (9)$$

This accounts for the power input to the system.

If it is required to examine the nature of free vibration, and to include internal damping with the attendant possibility of instability, then the equations may be studied in much the same way. The results are a little more complicated.

Continued on next page

X-Ray Spectrometer for Britain's Satellite

Electronic equipment has been developed for one of the experiments to be carried out by the first Anglo-American Scout space research satellite which is planned to go into orbit next year. The equipment has been designed and manufactured by the guided weapons laboratory of Bristol Aircraft Limited.

In the form of an X-ray spectrometer, this equipment was developed specifically for the Space Research Group at University College, London, and the Physics Department of the University of Leicester. There has been close cooperation between the university groups and the Bristol Aircraft research team on the development of the spectrometer, which will be used in an experiment to obtain data for the correlation of ionospheric behaviour with solar X-radiation outside the earth's atmospheric shield.

The spectrometer measures the rate of incidence of X-rays in five energy bands within the range of 2 to 13 angstroms. X-rays are detected by a proportional gas counter which produces pulses whose heights are proportional to the energies of the incident rays. The minimum pulse separation is one microsecond.

The pulses are amplified by about 72 decibels in a low-noise stable-gain amplifier and are then sorted into five energy bands by a pulse height discriminator. The five bands are interrogated sequentially by a gate which is controlled by the satellite's master clock. Each band is interrogated for one second in each operation cycle.

The pulses occurring during each interrogation period are accumulated in a 15-stage binary counter. At the completion of each count, the contents of the counter are transferred direct to the telemetry system for transmission to the ground. If the satellite is not actually in contact with ground stations at the time, then the contents of the counter are stored on a magnetic tape so that it can be read out when Earth contact is made next time.

An X-ray spectrometer, weighing only 310 grammes, has been developed by Bristol Aircraft Limited for Britain's first space research satellite.

The equipment is fully transistorised and is designed to operate on less than 100 mW of power, which is delivered from the satellite's solar cell power system. Referring to the spectrometer in a lecture given at the invitation of the British Interplanetary Society in London last September, Dr. A. P. Willmore (of University College, London) said: "I think that it can be fairly said that the performance of this equipment rivals the best that has been built anywhere with this sort of power consumption."

UK Scout 1, as the first Anglo-American vehicle is now being called in Great Britain, will consist basically of a 23 in diameter, 10 in deep, central cylinder with a hemisphere at each end, the lower one carrying four solar-cell "paddles." The interior electronic equipment, including the spectrometer developed by Bristol Aircraft, is to be constructed in 5½ in diameter circular cards, or modules. The Bristol Aircraft package, comprising four modules which are encapsulated in polysulphide rubber and foam resin, is no more than 3 in in depth.

UK Scout 1, which will weigh 150 lb, will have a 55° orbit with a perigee of 200 miles and an apogee of 600 miles. It is anticipated that it will have a useful life of about 12 months.

Automatic Iron-Trace Detection

Iron traces as low as 1 part in 4×10^9 can now be determined automatically and continuously by using an analytical device developed and manufactured by the Technicon Instruments Company Limited, Warwick Road, London. Iron determination in the analysis is based on the intense violet colour which develops when iron complexes with Tripyridyl-s-Triazine. Highly specific for iron, this new reagent, commonly known as Tripyridyl or TPTZ, exhibits extraordinary sensitivity.

Known as the Technicon AutoAnalyser, this new automated colorimetric method for low-level iron determination was introduced at the 15th Annual Instrument and Automation Conference sponsored by the Instrument Society of America. The TPTZ method has been adapted to the AutoAnalyser from a procedure developed by research workers at Iowa State University and the University of Illinois, in the USA.

Useful for anticipating the formation of rust and corrosion in high pressure/high temperature boilers and turbines, this technique is a valuable addition to industrial and power-plant instrumentation. Such deposits (if not detected early enough) may clog boiler tubes, lower system efficiency, and eventually necessitate blow-down of the boiler. Therefore, it is important to be able to detect the impending condition long in advance. The lower the amount of iron traces that can be detected, the sooner a trend can be spotted and corrections made.

While the primary application of the new method is found in power plant chemistry, other industrial and scientific uses of the TPTZ Auto-Analyser are readily apparent.

Iron is the fourth most abundant element in the Earth's crust; widely distributed among the soils, rocks and minerals, it is one of the essential "trace" elements. Since its presence in many manufactured goods is objectionable, its determination is not only frequently critical but it is also one of the commonest tasks that the analyst is called upon to perform.

In addition to checking for iron in high-purity boiler water for example, the TPTZ method is being used to determine low-level iron traces in treated municipal and industrial water, seawater, wine, blood, urine, and reagent chemicals. All determinations, significantly, are performed in a water medium.

In the high-purity boiler water application, the AutoAnalyser handles detailed colorimetric analyses automatically, eliminating the tedious task of making frequent repetitive tests of samples by manual means. The boiler water sample is taken continuously. Sampling, measuring the sample, separation and the recording of results are all automated *on stream*; the analyser completing all the steps in a few minutes instead of the usual 30 minutes required for manual analysis.

A chart recorder automatically graphs the reading of absorbance as a percentage of the transmission. Since the trace determination follows Beer's Law at the concentrations involved, the chart record is simply related to iron parts per thousand million through the use of a standardised calibration curve.

Results are obtained in a steady flow without any attention, and they can be reproduced with a considerable degree of precision. The system is self cleansing, so that each sample remains uncontaminated. Sample-size, time and temperature are constant, and the unknown is checked against a continuous stream of standard sample. Because no absolute measurements are involved, dependable iron determinations as low as one-quarter of a part per thousand million can now be made.

In the power industry, Technicon Auto-Analysers are now being used to determine the efficiency and breakpoints of ion exchange columns in demineraliser units, as well as being used as many as 240 times a day to sample and analyse boiler feedwater continuously for stream generating units.

Concluding Unbalanced and Initially Bent Shafts

BALANCING

The problem of balancing a shaft suffering from mass unbalance is that of removing the offset e in Fig. 1. This is accomplished (in the terms of Jeffcott's analysis) by the attachment of a small mass ($\ll m$) to the surface of the shaft opposite the mass m. By nullifying the offset e, one precludes the possibility of whirling.

The best that can be done with a shaft having elastic unbalance is to attach a small mass to the surface on DO produced (Fig. 3) so as to superimpose a mass unbalance offset e of magnitude ϵ. The resultant vibration is then such that

$$r = \frac{\epsilon(\omega_1^2 - \Omega^2)}{\sqrt{[(\omega_1^2 - \Omega^2)^2 + 4\mu^2\Omega^2\omega_1^2]}} \qquad (10)$$

There will then be no vibration at the critical speed $\Omega = \omega_1$ although a small residual vibration will persist off resonance. The only way of suppressing the vibration at *all* speeds is to treat the motion as a criminal offence and to treat it in the manner suggested by Butler[7]; this involves removal of ϵ.

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Alloy Base for High Temperature

The need for structural materials to work at temperatures above 1,100° C has led to the consideration of tantalum as an alloy base. In spite of its high density, tantalum possesses the advantages of having a very low ductile-to-brittle transition temperature, being a refractory oxide, and having high melting point.

As part of a broad investigation on the strength and oxidation properties of tantalum for the materials laboratories of the Wright Air Development Division in the USA, workers at the Battelle Memorial Institute have explored the effects of alloying on the oxidation behaviour of tantalum. This research has resulted in the following conclusions being drawn:

1 The most effective binary additions for improving the tantalum oxidation at 1,000 to 1,400° C are the Group IVA elements titanium, zirconium and hafnium. Moderate improvements result from adding vanadium, columbium, chromium, molybdenum, tungsten, silicon, boron, iron and nickel.

2 The depth of subsurface contamination hardening of tantalum is significantly reduced by thorium, silicon, vanadium, titanium and tungsten. With the exception of vanadium and tungsten, these elements form oxides which are more stable than tantalum oxide, resulting in the formation of an internal oxide dispersion.

3 Oxidation behaviour of tantalum ternary alloys investigated was about an average of the behaviour obtained when the same elements were added as binaries.

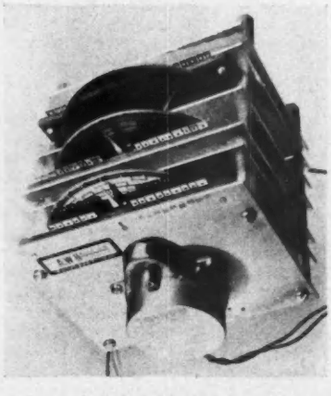
4 The oxidation behaviour of tantalum alloys could be correlated with both the ionic radius and the oxide properties of the added element.

5 The effects of alloy additions on the contamination behaviour of tantalum could be correlated with thermodynamic oxide stability, atom diameter and melting point of the alloy additions.

New Binary Code Generator

A new concept of binary time code generation for data processing, transmitting, computing, and automatic control systems has been developed by the A. W. Haydon Company, Connecticut, USA.

Developed in response to the rapidly increasing demands of industry and the Armed Forces for an inexpensive means of presenting accurate electrical output signals in digital coded form, the new devices are basically shaft position encoders. The technique is based on the conversion of analogue data (in the form of shaft position angles) into a digital output represented by a coded pattern of electrical signals. Although the units being produced at the moment are basically binary time coded, it will be possible to obtain many types of output code and a wide range of timing periods.



The new binary time code generator is said to be suitable for data processing, transmitting, computing and automatic control systems. The disc in the foreground codes minutes, the centre disc codes hours and the third disc codes days and weeks.

One version of the Haydon generator has been designed for a high volume commercial application requiring low cost and trouble-free maintenance. It is at present installed in a completely automatic parking-lot computing system and handles most standard schedules of parking fees, and operations involving validation of tickets by local merchants. When parking tickets are placed in a "time-out" slot, the device automatically determines the length of time the car has been in the garage and computes the appropriate charge. Three code discs provide 20,160 discrete coded output signal combinations over a 28 day period.

A military version of the same code generator consists of a synchronous motor driving two printed circuit code discs, with each circuit having a switching pattern representing 0 to 59 in decimal binary code. Together they provide 3,600 consecutive coded time periods through 59 minutes and 59 seconds, after which they recycle.

Another version of the binary encoder has been developed as a binary-time, digital master clock. Having an illuminated display which indicates time in minutes and seconds (up to 999 minutes), the unit provides positive synchronisation between the master clock and slave clocks at all times. Binary code time signals are generated by motor driven code discs within the master clock assembly, and these signals are made to energise the digital readouts for both the master and any number of slave clocks.

The desired display time can be reset or preset manually. The clock will operate directly from mains or from an external, crystal-controlled, pulse source.

Plate-Glass Fluorescent Lighting

Flat, rectangular fluorescent lamps, representing a new concept in fluorescent lighting, have been developed and are shortly to be marketed by the Westinghouse Electric International Company in the USA.

These new lamps, which actually consist of a labyrinth of passages sealed in a thin glass block, are in a plate-glass form having a thickness of only 1½ in. The electrical discharge is made to pass through what is effectively a long winding path,thus giving the result of a large area source of light.

The prototype model, which Westinghouse plans to mass produce, is 1 ft square with a small set of electrical contacts at the rear. They will be rated at 40 to 50 watts and will produce considerably more light than a normal 100 watt incandescent lamp. They will have a backing reflector surface so that all of the light output will appear on one side.

These new lamps can be installed in modular fashion, just like glass bricks or ceiling tiles, to form blocks of light in walls, ceilings or even floors. Eventually some models may be manufactured in heavy, shock-resistant glass, thus opening up the possibility of using them in road surfaces or airfield landing strips.

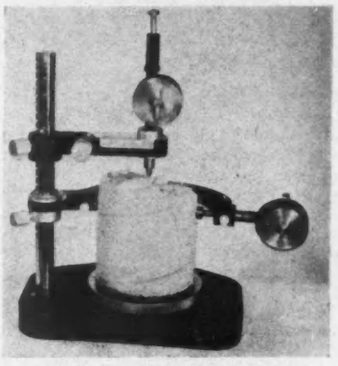
Simple Concrete Test-Core Measurement

A versatile new measuring instrument, for quickly and accurately determining the length and diameter of drilled concrete sample cores has been developed by Soiltest Incorporated, Chicago, USA.

The new indicator is intended to be used on samples that have been core-drilled from concrete structures for checking the completed work with construction specifications as to thickness, quality and strength. It is designed to enable these to be checked rapidly and with consistently accurate results.

The indicator has an indexing rotary on which 4 or 6 in diameter concrete cores are placed. This table locks into eight positions for measuring the core length up to a figure of 12 in. It also locates at the two positions required for diameter measurements.

The portion of the indicator for measurement of diameter is detachable, thus making two independent measuring units for diameter and length.



A new type of measuring instrument has been developed for quickly and accurately determining the length and diameter of concrete test cores.

Television Under Water in Scotland

An underwater television camera has been ordered by the North of Scotland Hydro-Electric Board for research into hydraulic problems on the Scottish lochs. Among other things, the camera will be used to inspect the huge fish screens which guard the turbine intakes and prevent smolt (young salmon between one and three years old) from being swept into the turbines. The job of inspecting these screens was previously carried out by divers.

The camera, which is manufactured by Marconi-Siebe, Gorman, will also be used to study fish behaviour in the special fish passes and to inspect the tunnels linking the dams and power stations. Engineers will therefore be able to report on the condition of the tunnels without going to the considerable expense and trouble of dewatering.

When it is finally in general use the closed circuit television equipment will be taken from loch to loch all over Scotland for on-the-spot investigations and research.

Giant Computer for Nuclear Research

Three large aircraft have just brought to Geneva Airport an IBM 709 electronic computer, consisting of 25 separate units and weighing 19 tons altogether.

When it is installed on the site of the European Organisation for Nuclear Research (CERN), this machine will be the biggest of its kind in operation on the continent of Europe. It will be able to perform 42,000 operations per second. It is equipped with a magnetic "memory" capable of 327,680 digits, each of which can be reached in 12 millionths of a second. These facilities enable it simultaneously to perform computations and to store and produce information at the rate of 25,000 digits per second.

Since 1958, CERN has had an electronic computer similar to those used in several European laboratories, but it proved inadequate, to meet growing computing needs.

Secondary Surfaces for Heat Transfer

Reliable data for the performance of extended tube surfaces have been rather limited, but a symposium recently held in London will lead to a more coherent knowledge.

IN THE world of heat transfer, a primary surface is one such as a plain tube or a solid rod possesses. Secondary surfaces are those which can be described as extended surfaces such as finned or studded tubes.

A recent symposium held at the Institution of Mechanical Engineers had as its title "The Use of Secondary Surfaces for Heat Transfer with Clean Gases." One paper presented by Mr. N. G. Worley and Mr. W. Ross dealt with experiments carried out on tubes with studded surfaces. Significant points from this paper are given below.

The performance of banks of bare tubes in a variety of patterns is well established and this information has passed into the general literature on heat transfer. Even so, data for high flows are meagre. The design of boilers for nuclear power stations has led to the use of finned tubing with high surface ratings and high gas pressures associated with high gas speeds. To establish the essential design information it has therefore been necessary to carry out large-scale test programmes.

This paper summarised results from one of those programmes of development, during which over 200 arrangements were tested. As a result of this work, and experience from Calder Hall and Chapelcross, it has been possible in recent designs to reduce boiler margins and produce more compact arrangements.

Extended surface tubes are now manufactured by a number of methods, all of which have been used in stations under construction or in operation. In the test programme, many of the types of surfaces were investigated but for brevity, only the studded tube results are reported.

In the main series of experiments three test rigs were employed. Throughout the work the direction of heat transfer has been from a hot gas to the element as in the final boiler design, but in the rig the tubes were cooled with water below its boiling point to check the heat flow.

The results of a bare tube test series (see Fig. 2) were given for comparison with the stud tube tests and to establish the general reliability of the test methods as compared with published data. The arrangement chosen was that used in the high-pressure superheaters at Calder Hall and Chapelcross with 2 in tubes on 4⅛ in transverse pitch and 2¾ in between the staggered rows. This arrangement was similar to those used for extended surface tests.

Studded tube characteristics were dealt with as a number of specific subject investigations which gave a general indication of the important parameters and how they affect performance.

Stud Cross-Section.—One of the features of studded tubes is that the designer can use studs of any suitable shape and can arrange them on the tube in various ways The range of cross-sections investigated is shown in Fig 1, and the results summarised in Fig. 3.

The experiments showed that:

(1) Although the overall coefficients of heat transfer for the stud designs are not the same, when allowance is made for the different fin efficiencies associated with the cross-sections, it is found that the stud shape does not influence the mean local heat transfer coefficient

(2) The stud shape has, as expected, a pronounced effect on the pressure drop. There is little difference between the elliptical and chamfered shape, both giving values less than the rectangular section.

(3) The turbulence associated with the flow around the poor-shaped fins and giving high pressure losses does not break up the boundary layer to give improved heat transfer.

Gas Gap Between Neighbouring Studs.—For tubes with staggered arrangements with chamfered studs there are two ways of changing the gap between the studs available for gas flow, by varying (i) the number of stud rows per inch; and (ii) the thickness of the studs. A comparison was made between banks with 2 and 4 staggered rows of studs per inch. There was no noticeable difference in the Nusselt number lines and therefore in the heat transfer coefficient figures, while the pressure loss factors showed a difference of 0·35 velocity heads, the lower figure corresponding to the wider stud pitch.

Different stud thicknesses were also adopted at 4 rows per inch and the results showed that once again there was no effect on the heat transfer coefficient, but at 0·2 velocity heads increase in the pressure loss factor appeared as the stud thickness increased from $\frac{3}{16}$ in to $\frac{1}{4}$ in.

Stud Arrangement Around the Tube.—This design aspect was studied from 3 points of view: (1) Omission of surface from certain positions on the tube. Wherever surface was left off the tube the effect in the local heat transfer coefficient was insignificant.

(2) In line, as compared with staggered arrangements, and (3) changing the number of studs per row. Results indicated that the arrangements with eight or ten studs per row gave superior heat transfer coefficients and lower pressure loss factors. The size of the improvement in the pressure loss factor is a consequence of the gas flow area convention used. Unfortunately, cutting the size of studs and adopting in-line patterns reduces the amount of surface that can be applied per unit length of tube.

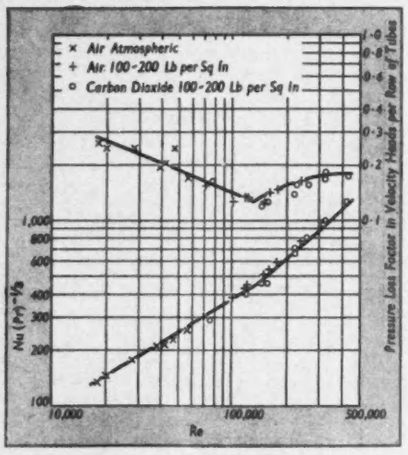

× Air Atmospheric
+ Air 100-200 Lb per Sq In
○ Carbon Dioxide 100-200 Lb per Sq In
Nu (Pr)^-1/3
Re
Pressure Loss Factor in Velocity Heads per Row of Tubes

Fig. 2 Tests on bare tubes.

Tube Diameter Comparison.—Agreement both for pressure drop and heat transfer is more satisfactory than would be expected as complete dimensional similarity was not maintained. It is clear that a prediction of performance can be made from one tube diameter to another.

Tube Pitch Comparison.—Comparisons were made for a large proportion of the surfaces tested and it has been found that there was a marked variation in the performance with the transverse pitch while the pitch of the tube rows has only a slight effect.

CONCLUSION

The tube appears to be more important than the studs in fixing the heat transfer coefficient. This is shown by the correlation, using tube diameter as the characteristic dimension, which successfully brings to a single line the curves for tubes of different diameters (but similar pitch ratios referred to tube diameter), although complete dimensional similarity of the stud patterns was not maintained.

The general slope of heat transfer curves corresponded to an intermediate condition between the medium and high flow regimes shown in bare tube tests. Changes influencing strongly the pressure drop do not necessarily give corresponding changes in heat transfer performance.

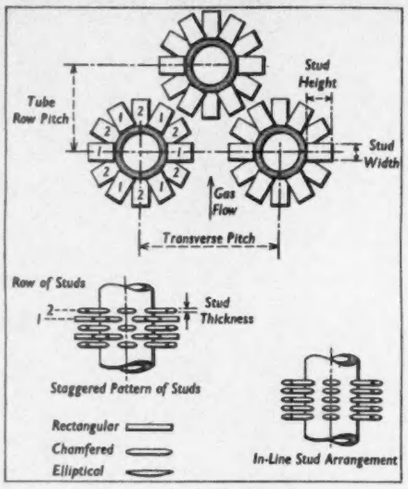


Fig. 1 Stud tube details.

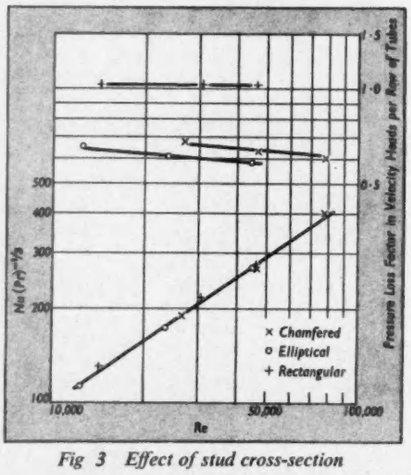


Fig 3 Effect of stud cross-section

Tube pitch influences the heat transfer coefficient although the variation is less than occurs with bare tubes. On the other hand, the performance is remarkably insensitive to a large range of variations in stud details as long as the general pattern is maintained.

Generalisations on the pressure loss factors are not so simple. Stud shape and the relation between stud blockage and gas flow area have significant influences. The curve of pressure loss factor against flow rate shows no pronounced flow regime corresponding to that obtained with bare tubes, and within the test range there was always some reduction with increase in Reynolds number. With well-shaped studs the total pressure loss per unit swept area is less than that for a similar arrangement of bare tubes but the heat transfer coefficients are similar.

For an untested configuration of a wide range of surface patterns and tube pitches, reasonably precise predictions of heat transfer performance can be made from present information while only the order of the pressure drop can be estimated. More comprehensive theories are required to explain the results and it is hoped that the information collected in the symposium will lead to a more coherent general presentation of extended surface data than is possible today.

Screw Type Compressor Gives Oil-Free Air

It became apparent some time ago that a ready market was available for a compressor capable of delivering oil-free air at pressures up to 30 lb per sq. in without resorting to a two-stage Root's blower. Conscious of this potential, Sir George Godfrey and Partners Limited, Hanworth, Middlesex, have designed and are manufacturing under licence from Svenska Rotor Maskiner of Stockholm a screw-type compressor which is known as the Godfrey/SRM compressor type 220. Godfrey's have for many years produced a comprehensive range of Root's blowers but as is generally known such machines have an output limited to about 12 to 15 lb per sq. in.

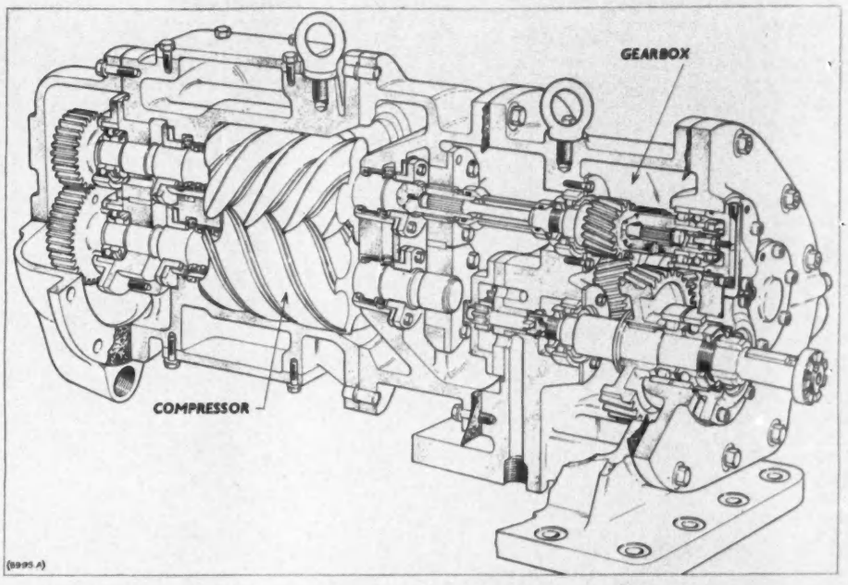
The new compressor—which can be applied to such installations as pneumatic conveying of powders and granular materials—is surge-free, and because of the absence of reciprocating parts is free from vibration. It has a maximum output of 450 cu. ft per min at 30 lb per sq. in and absorbs approximately 60 h.p. Two intermeshing rotors enclosed within a chamber form the compressing unit. The male rotor has four helical lobes and the female rotor six corresponding gullies. This 4 + 6 rotor combination as it is called imparts equal bending strength to both male and female members, a point which is desirable in machines designed for high-compression ratios. In operation there is no contact between the rotors and the walls of the chamber thus dispensing with the need for internal lubrication. Small running clearances provide an effective seal.

The drive to the compressor is through the male rotor which takes the full driving torque, the female rotor being driven by timing gears. Resultant forces due to gas and air pressure pass through the axis of the female rotor thus throwing very small loads on to the timing gears. The 4 + 6 combination means that the female rotor is driven at two-thirds the speed of the male rotor which it serves as a rotary seal.

OPERATING CYCLE

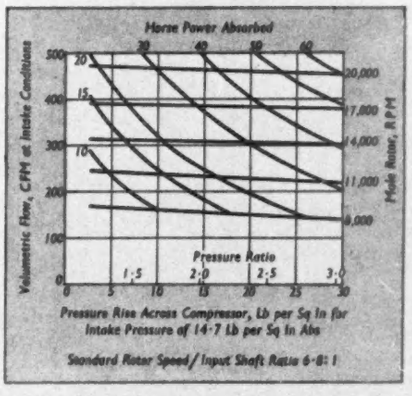
Briefly, the principle of operation is as follows: air enters the interlobe space between the two rotors, a space which increases with the continuing rotation; the volume of air inspired is determined by the "wrap" angle or angle of twist of the helix. The air is carried circumferentially around the rotor chamber through half a revolution of the rotors. Then the rotors begin to mesh, compressing the air between them. Further rotation causes the air to proceed axially towards the outlet port where further meshing of the rotors discharges the air from the chamber. It follows that the degree of compression is determined by the axial position of the outlet port.

It can be seen from the illustration used in the description of the compressor in our New Plant and Equipment section that the machine Godfrey's are offering is supplied on a baseplate, complete with a synchronous electric motor and speed increasing gearbox.



(Above) The Godfrey/SRM type 220 compressor delivers oil-free air at up to 30 lb per sq. in.

(Right) Performance curves for the compressor.


Horse Power Absorbed
Volumetric Flow, CFM at Intake Conditions
Male Rotor, R.P.M.
Pressure Ratio
Pressure Rise Across Compressor, Lb per Sq In for Intake Pressure of 14·7 Lb per Sq In Abs
Standard Rotor Speed / Input Shaft Ratio 6·8 : 1

Machined from the solid, in steel, the rotors are supported at each end in plain bearings and located axially by ball bearings at the free end. Carbon seals and a labyrinth system prevent the leakage of oil into the rotor chamber, but should any get through in spite of this, it is blown to atmosphere through a venting chamber. At the drive end the male rotor is coupled to the gearbox output shaft. The driven gear on the female rotor is split and dowelled to allow the inter-rotor clearance to be accurately set. The rotor chamber is formed by a machined casting closed at the drive end by a cover. Both items are in cast iron to allow water cooling to be used if necessary. Flanged air-inlet and outlet ports are integral with the compression chamber and situated on opposite sides so that the compressor can be fitted into a duct system.

Oil is pumped to the gearbox by a gear-type pump which delivers the oil from a tank fitted to the baseplate for the compressor and reduction gearbox, to a relief valve. From there the oil passes through a filter to the oil-cooler where it is fed back through the filter to a main-drilling in the gearbox. An external pipe takes the oil through three branch pipes to the compressor bearings and the timing gears.

Various versions of these compressors have already given service in missile cooling systems, and refrigerator sets (as pumps) and a new unit is being developed for the Vickers VC10 airliner cabin-pressurising system.

Petrol Engine Fabricated from Stainless Steel

A stainless steel internal combustion engine has made its début in the United States. Delegates gathered at the recent American Society of Body Engineers Technical Convention had an opportunity to inspect what is called "a remarkable new engine."

From information so far received it is only possible to build up the vaguest conception of the engine but claims for it include high power to weight ratio, lightness and durability.

The engine was designed by Lloyd Taylor and is produced by Tyce Engineering Corporation of Chula Vista, California. One model, weighing 175 lb is claimed to deliver 175 b.h.p.

Construction of the engine's cylinder block assembly is of AISI type 302 stainless steel and includes the combustion chambers, cylinders, water jacket, inlet and exhaust ports, cylinder head and sparking plug tubes. Brazing is used throughout.

Such a construction is said to do away with corrosion and because of the thickness of sheet used—about 16 s.w.g. in some sections—heat is more easily dissipated. It is also claimed that because of the uniform wall thickness, troublesome hot spots are eliminated—a cause of pinking in engines.

There is no cylinder-head gasket and a compression ratio of 14 to 1 is said to be obtained. Cylinder liners are fitted, 0·063 in thick, providing exceptional resistance to wear. There are two camshafts, and these and the crankshaft are said to be easily removable.

Four basic sizes of engine are available at 1,480, 1,720, 1,966, and 2,212 c.c. These can be converted from one size to another by fitting a different crankshaft to change the stroke. Cylinder bore is common at 3·5 in and all the engines in the range develop their maximum power at 6,500 r.p.m.

To prove the engine's potentials it has been installed in several boats and is scheduled to be tested in sports and racing cars. Standard parts from Detroit made cars were adopted for the engine, for instance, Thunderbird intake and Pontiac exhaust valves, Chevrolet-Six valve-guides and Ford-Six connecting rods. Numerous transmissions can be used and special adaptor units permit the engine to be fitted in such British cars as the MGA 1600, Triumph TR3A, and the Austin Healeys.

Heat Control

EACH type of heating system requires its own type of control, but all of them start with a thermostat of some sort.

The thermostat may be alone or be used in conjunction with a time switch to select the periods during which heating is possible. This allows advantage to be taken of cheap night tariffs and of making economies during week-ends. A neat circular wall mounting model is the one made by Honeywell Controls shown in the first illustration.

Known as the Day-Nite it incorporates a double setting so that one temperature can be selected for the day and another for the night. The lower temperature, and also the time at which the full temperature is needed are hand set. At the end of the set period the thermostat automatically raises the temperature setting so that the room will be warmed up ready for occupation.

A new control valve for hot water radiators is shown in the second illustration. An obvious feature is the heat graduation scale which is engraved to show the proportional heat output of the radiator and not the rate of flow of water through it, the two not being in direct ratio.

The conventional handwheel has been dispensed with and the valve instead has a sleeve which rotates in a cast gunmetal body. Only finger-tip force is required to operate it and the valve can be completely closed without exerting any more force than is needed to obtain one of the heat settings.

The evident advantage of having a calibrated heat scale is that guess work as to the number of turns open or closed is eliminated. The regulator is available in ½ in pipe size in both straight and angle patterns and a lockshield model is also made. To match modern decors the head is finished in ivory and the indicator plate in grey.

Mixing valves for supplying water at a chosen temperature are not new in concept, but a recent addition is the Leonard 621, said to be one of the smallest thermostatic mixing valves made. It is intended for flow rates of 1 to 1½ gallons per minute and at such rates the temperature of the output is held to within 2° F. Small showers or spray bib taps are two applications suggested by the makers but any constant temperature supply in the rated flow range would be a suitable project.

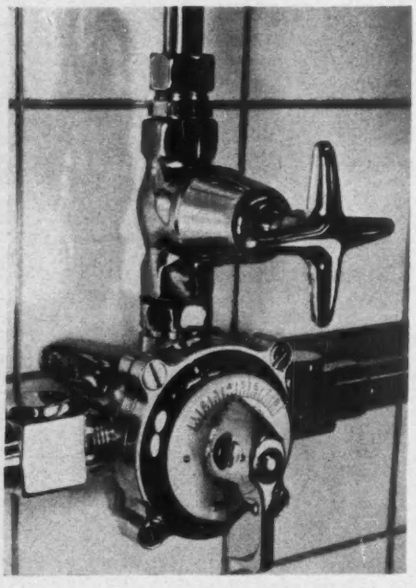
Compact design with a robust mechanism are two features claimed for the valve. The thermostat assembly is self-contained and fits in the valve body in the form of a cartridge. Replacement, using a single screwdriver, takes a matter of minutes—an advantage where continuity of supply is important. The thermostat itself is a sensitive robust bimetal strip coil. The hot and cold water supplies enter a mixing tube through circular ports, the opening of which is controlled by a concentric sleeve rotating inside the tube. This sleeve is connected directly to the thermostat which is situated over the outlet of the mixing tube. The response is rapid.

Also in the Leonard range is a thermostatic valve for temperature control in small bore heating systems. This is similar in principle to the mixing valve already described but is designed for flows in the range of 3 to 3½ gallons per minute with a pressure drop across the valve of not more than 6 in water gauge. In action, hot water from the boiler is mixed with cold water from the return pipe in such proportions that the temperature of the water flowing out to the system is kept constant irrespective of the losses from the radiators which will, of course, vary with the climatic conditions. The result is reasonably constant room temperatures, especially as with small bore systems, the response is quite fast.

(*Above*) *Heat output from the radiator is marked on the scale.*

(*Left*) *Two temperatures for day and night can be set on this thermostat.*

(*Below*) *Hot and cold water are mixed to give a constant temperature output.*



Honeywell Controls Limited are at Ruislip Road East, Greenford, Middlesex; the address of Hattersley (Ormskirk) is Ormskirk, Lancashire, and Leonard valves are made by Walker Crosweller and Company Limited, Cheltenham.

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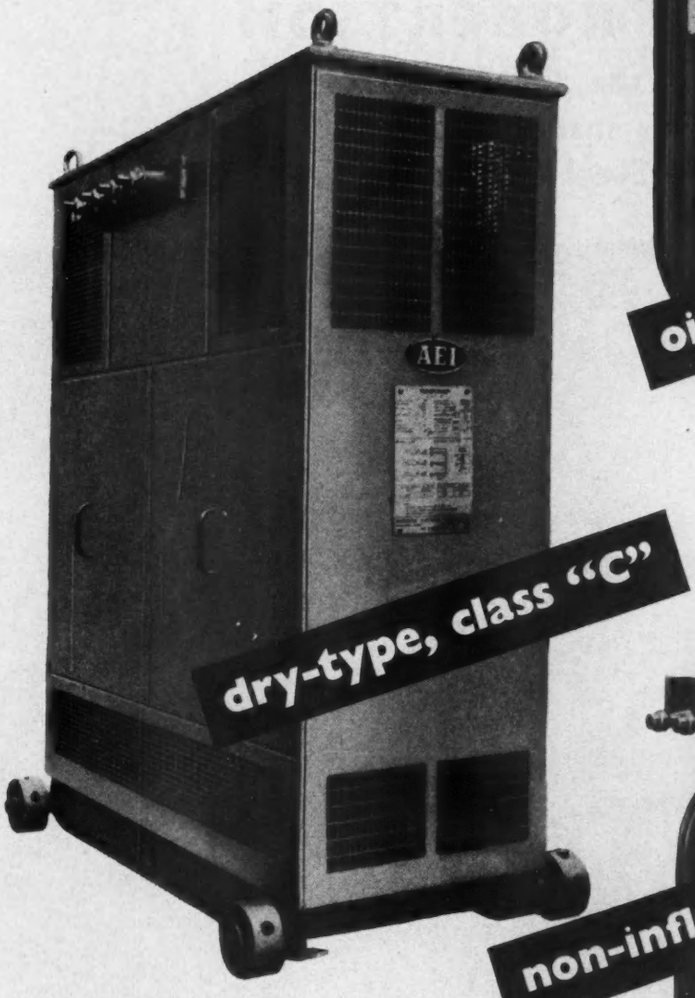

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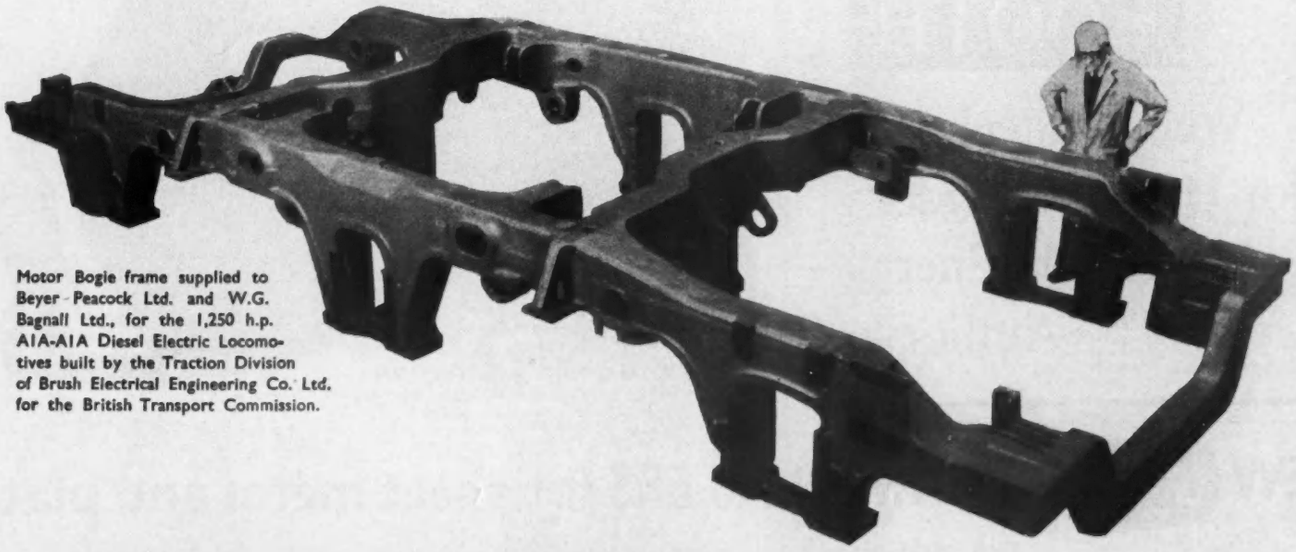

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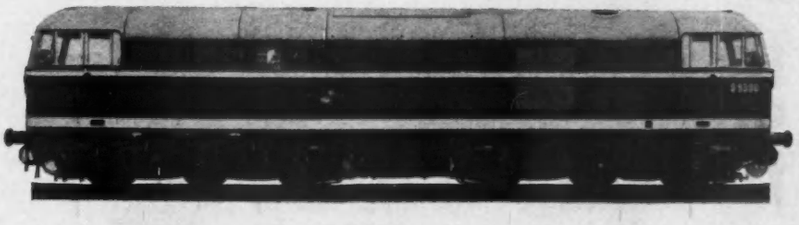

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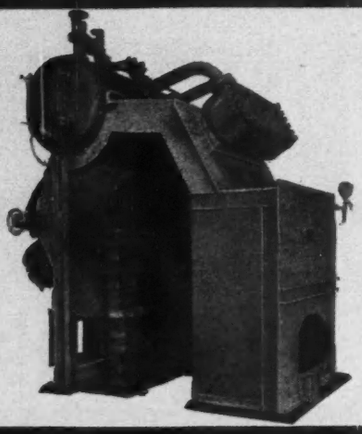

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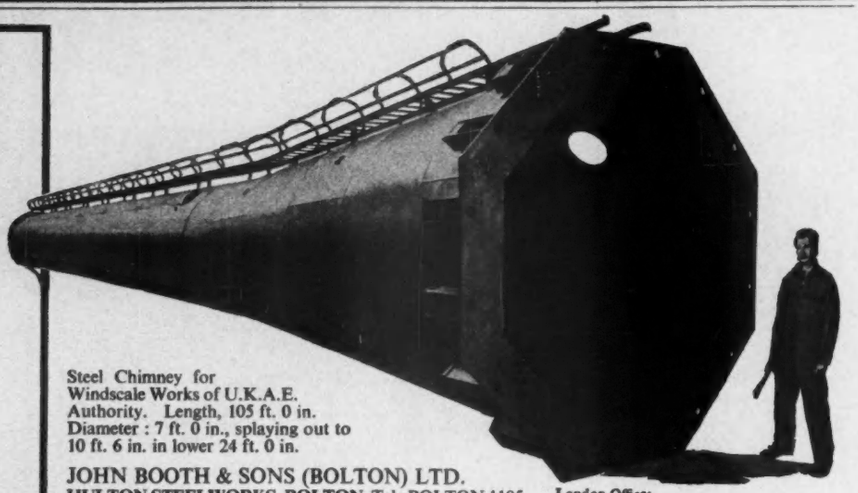

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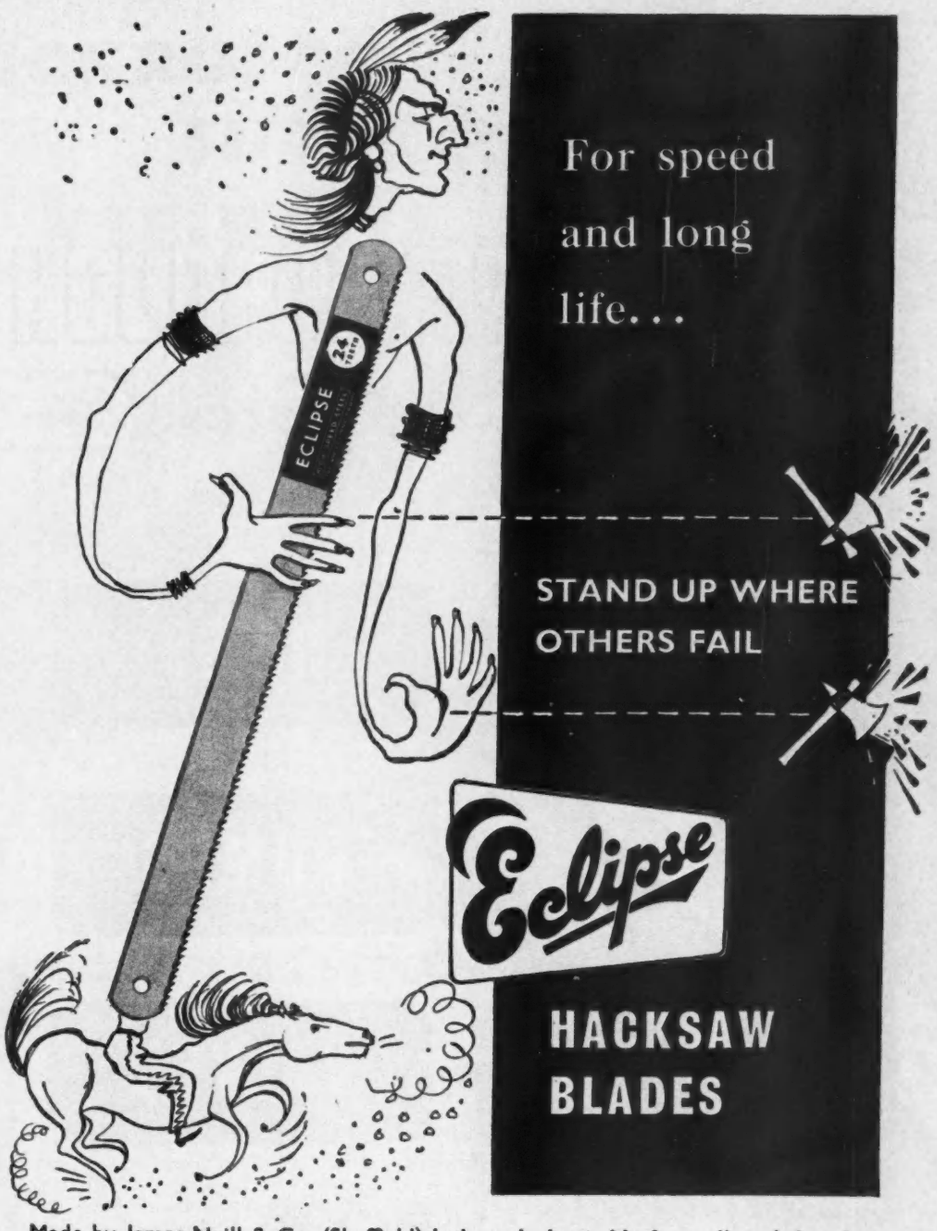

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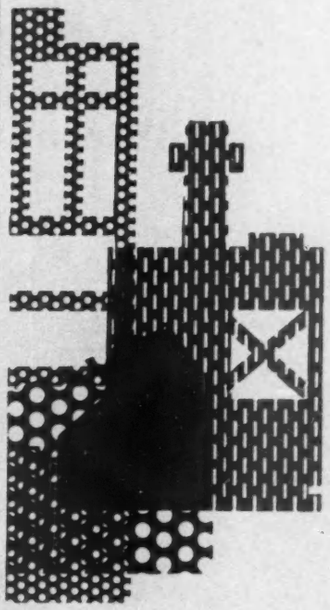

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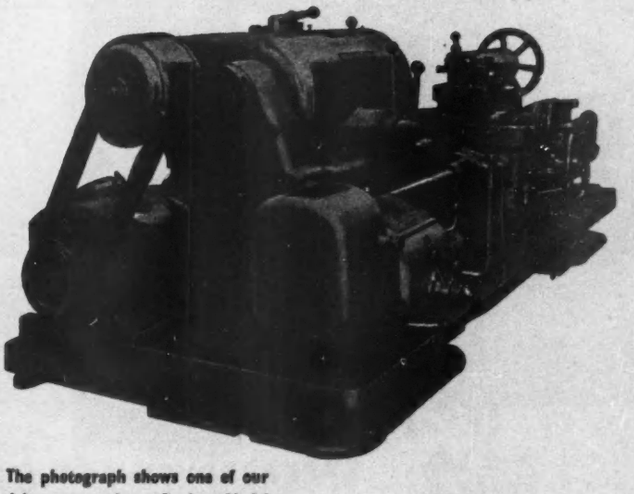

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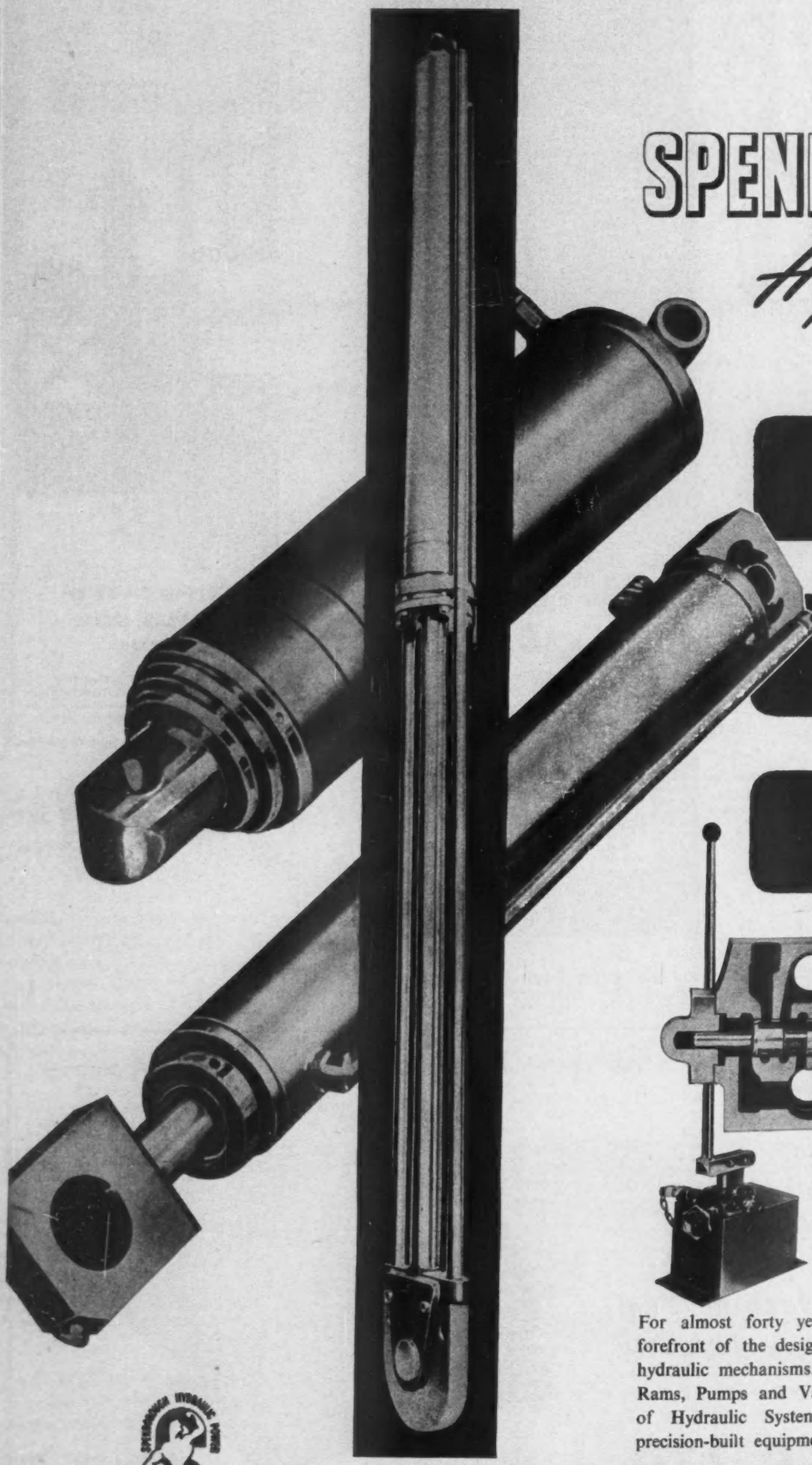

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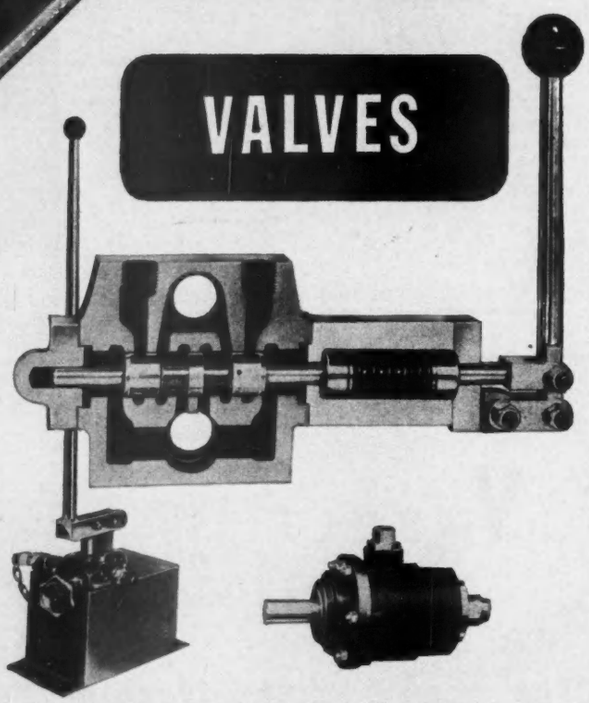

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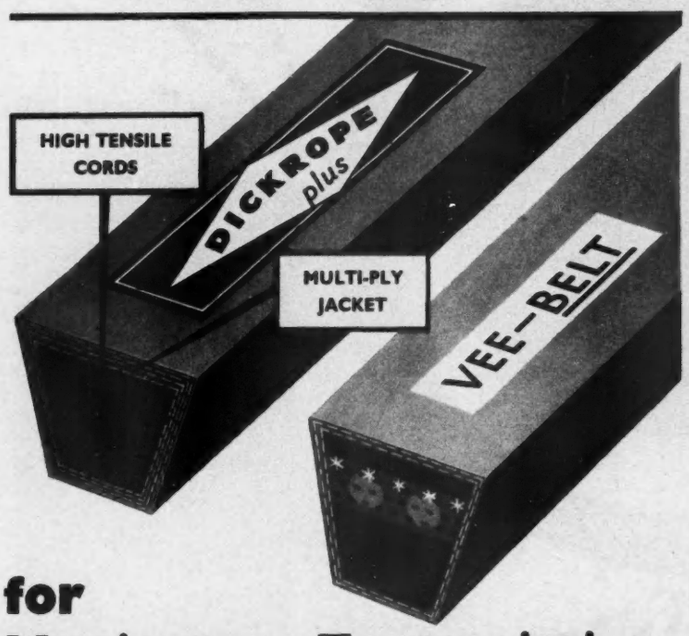

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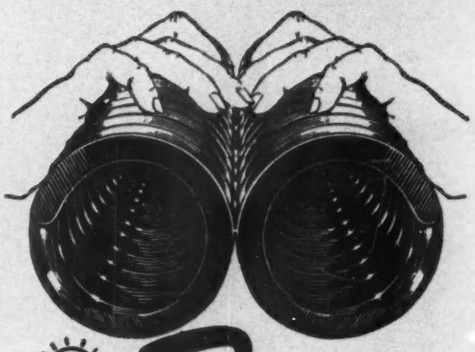

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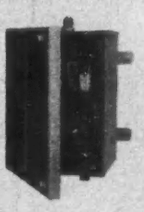

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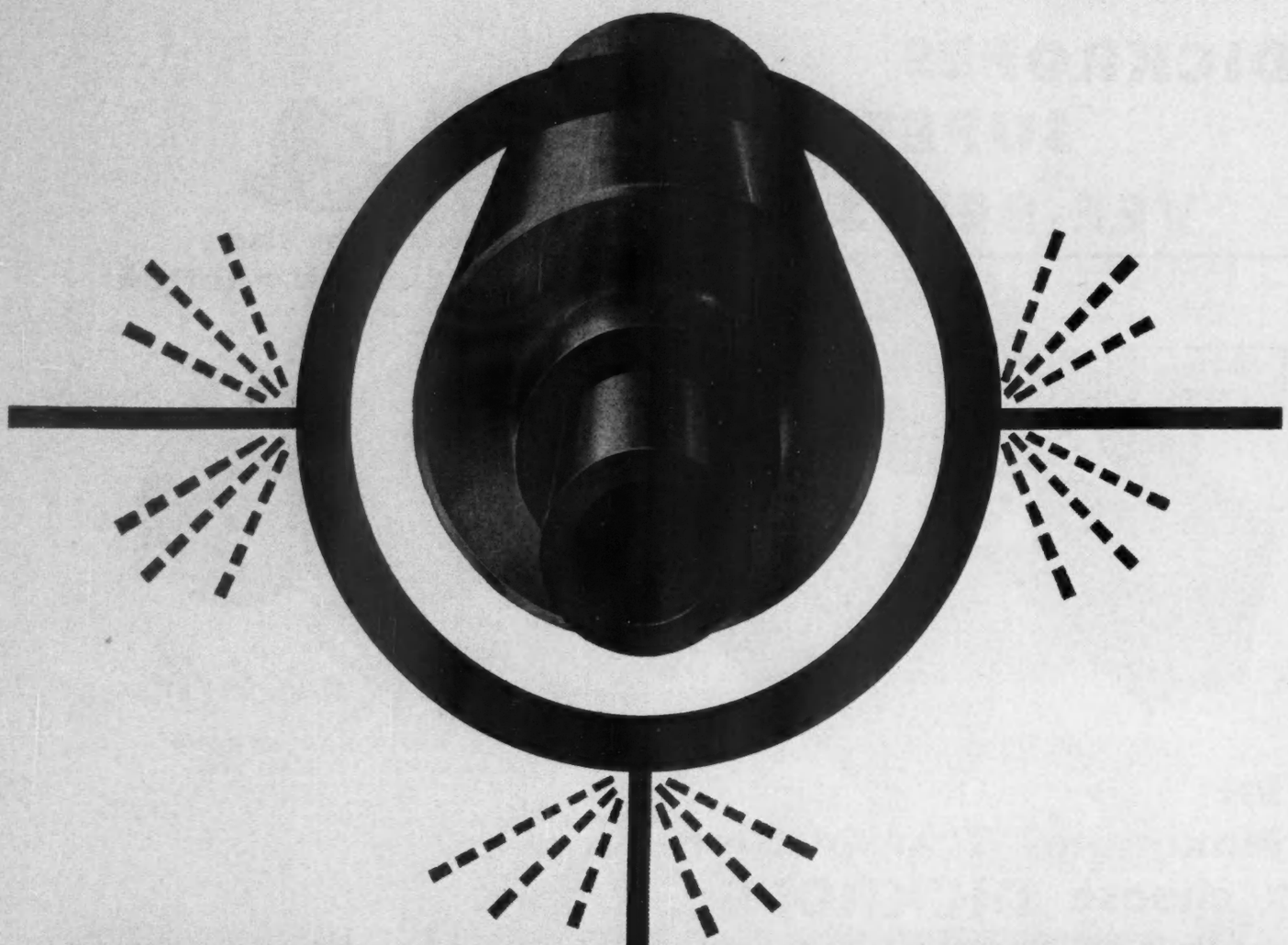

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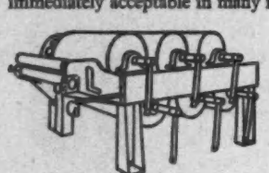

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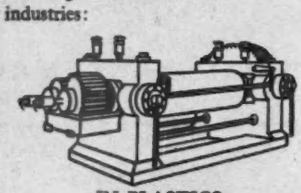

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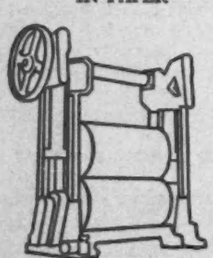

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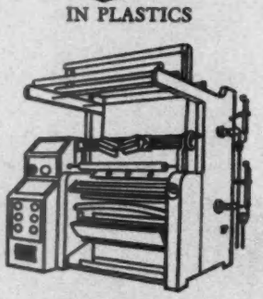

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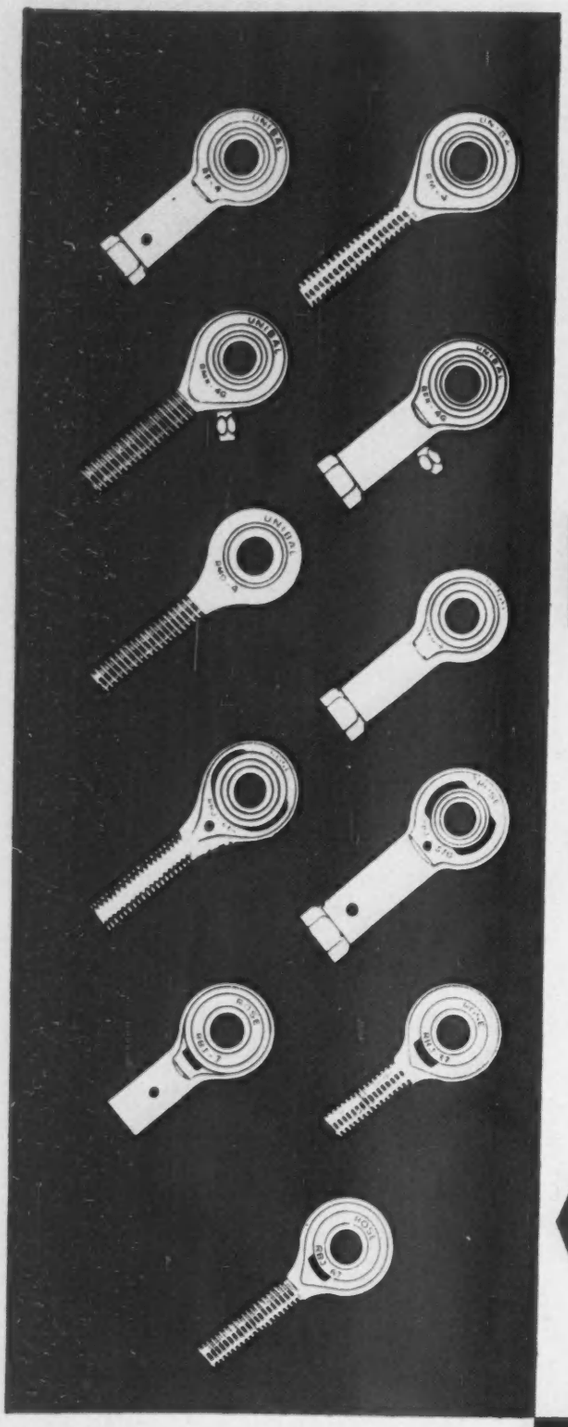

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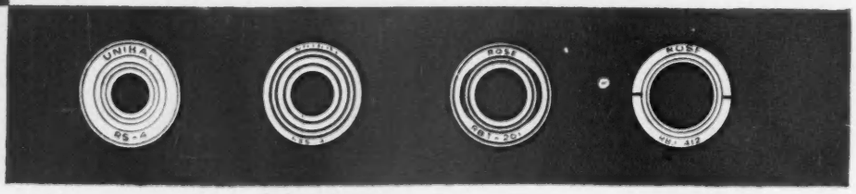

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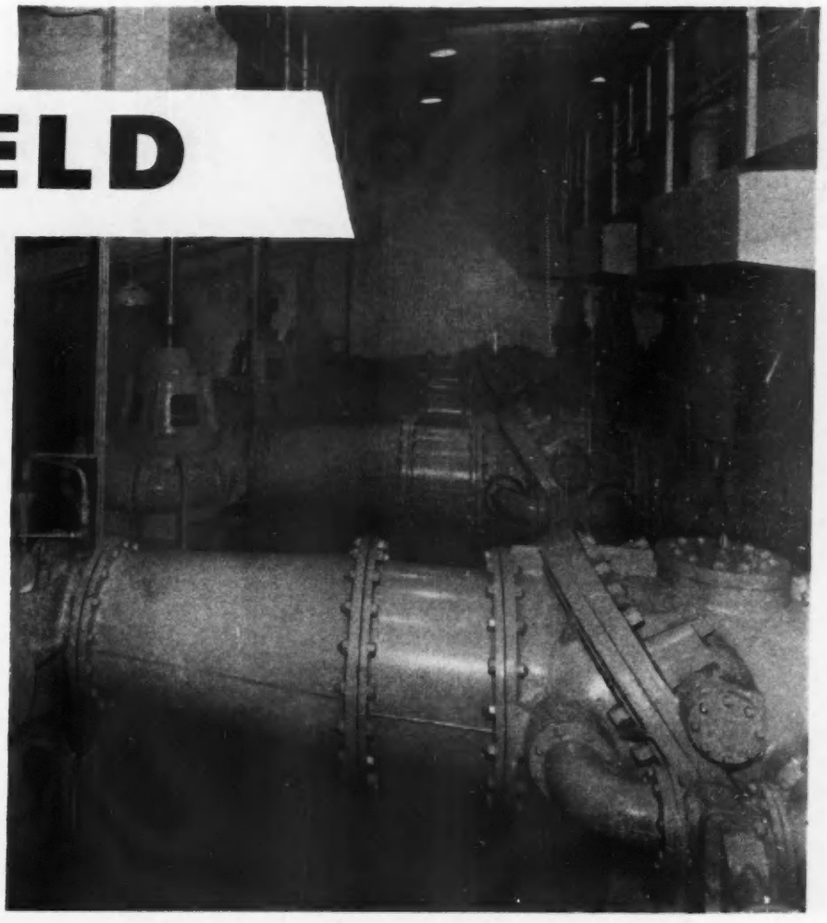

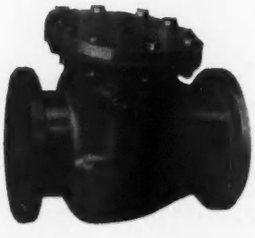

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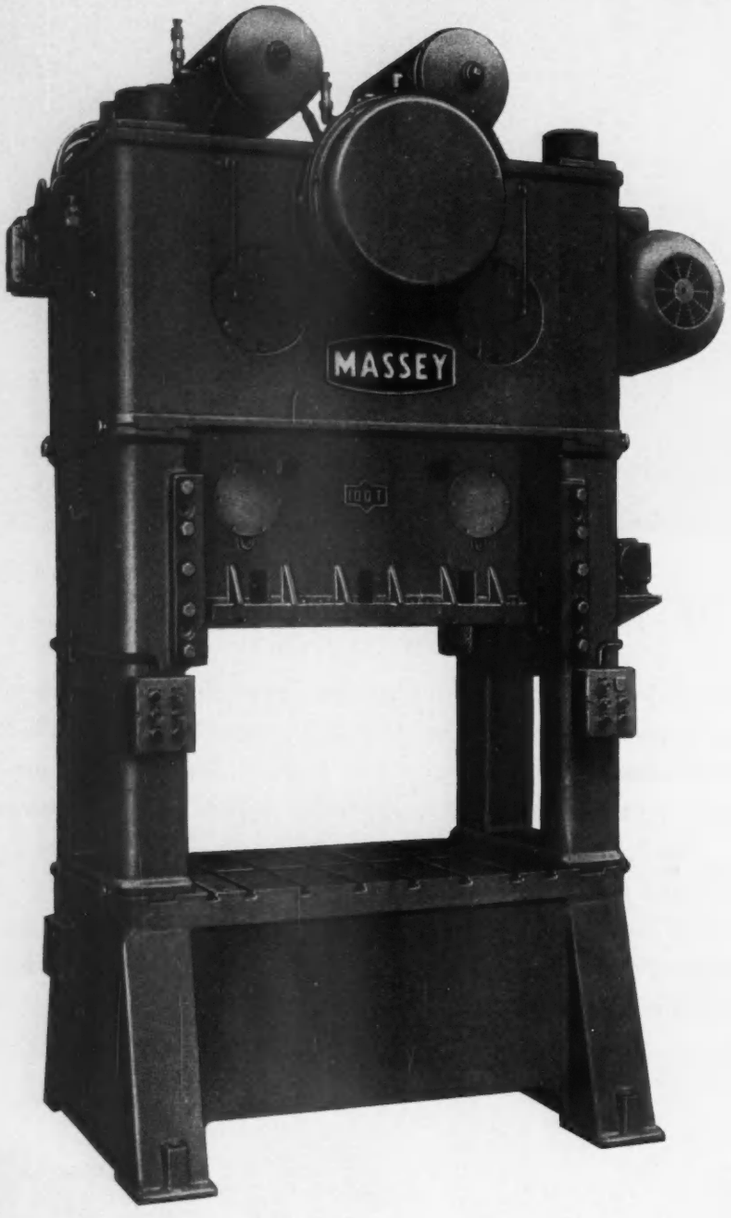

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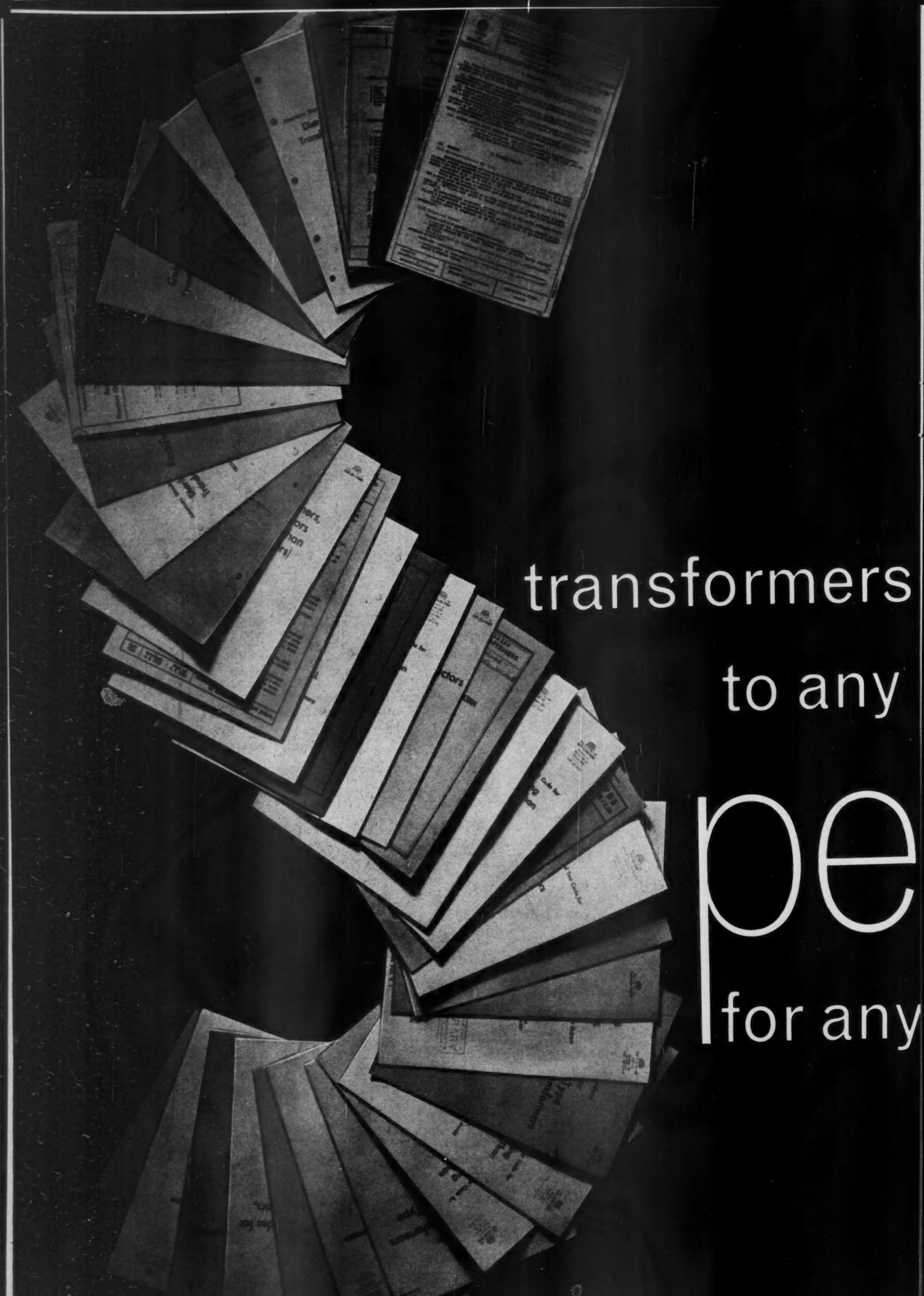
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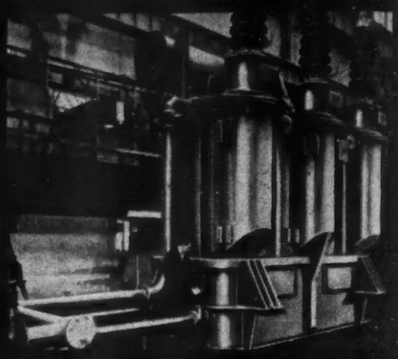

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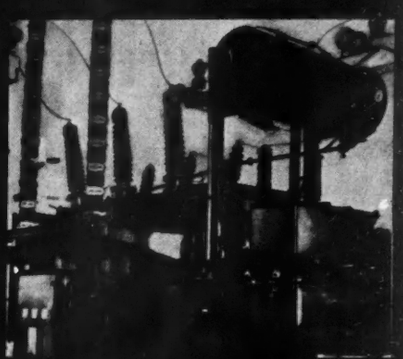

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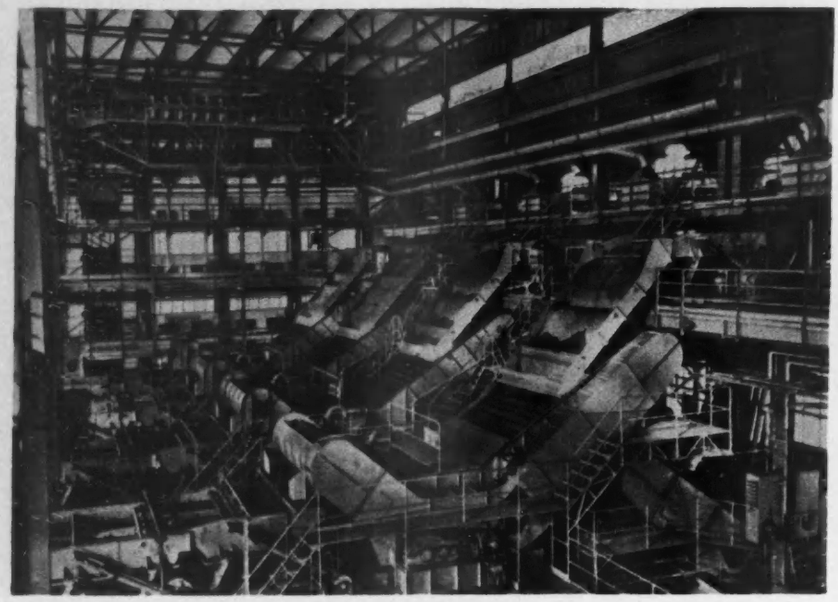

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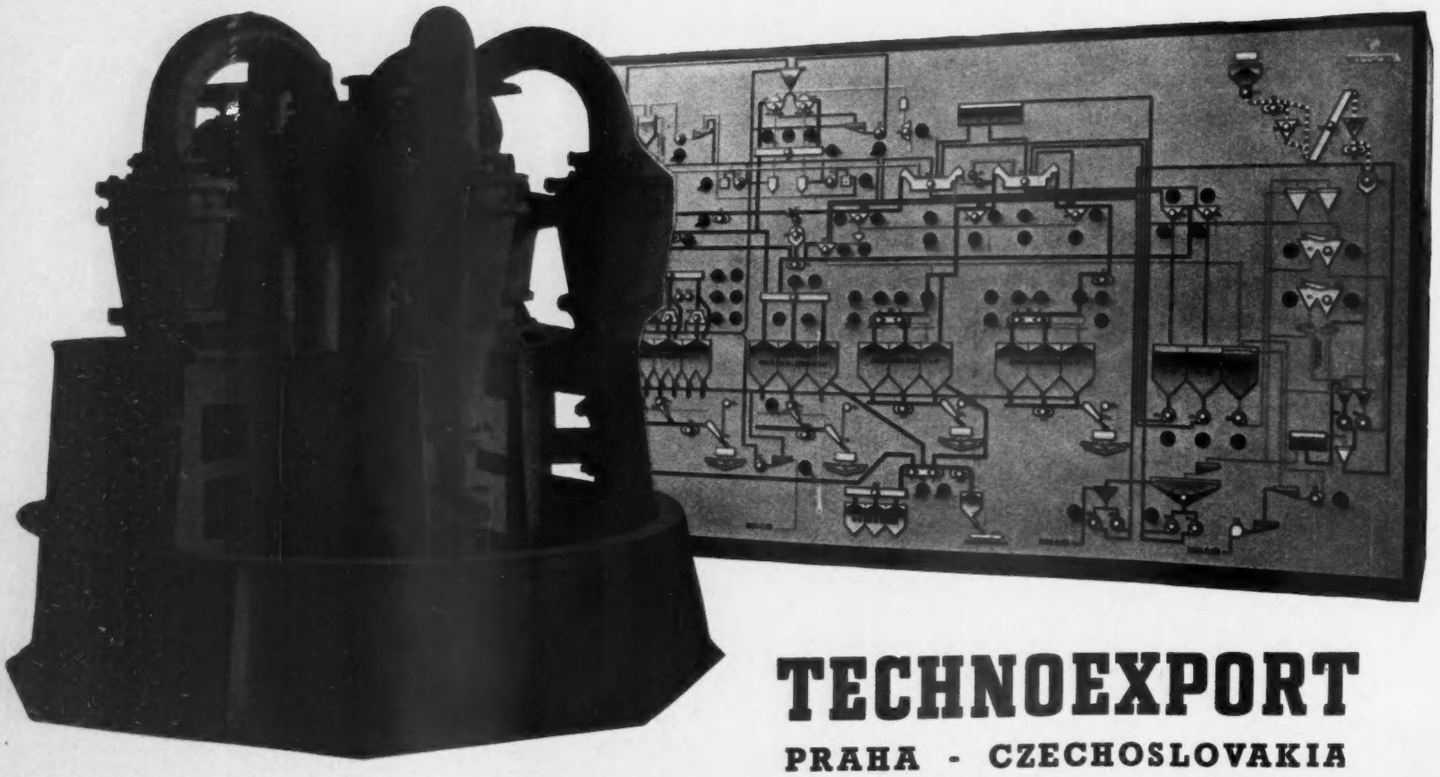

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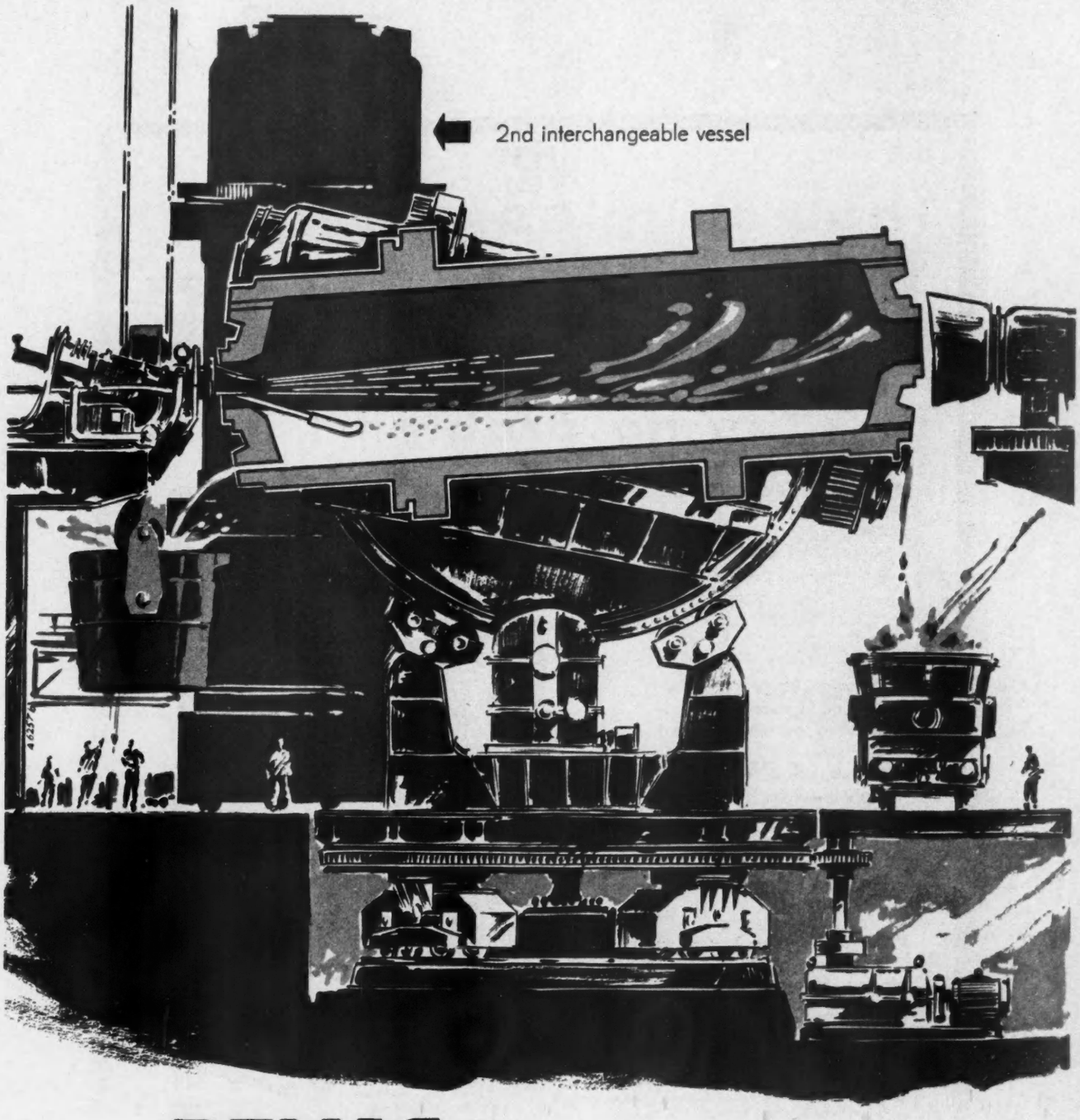

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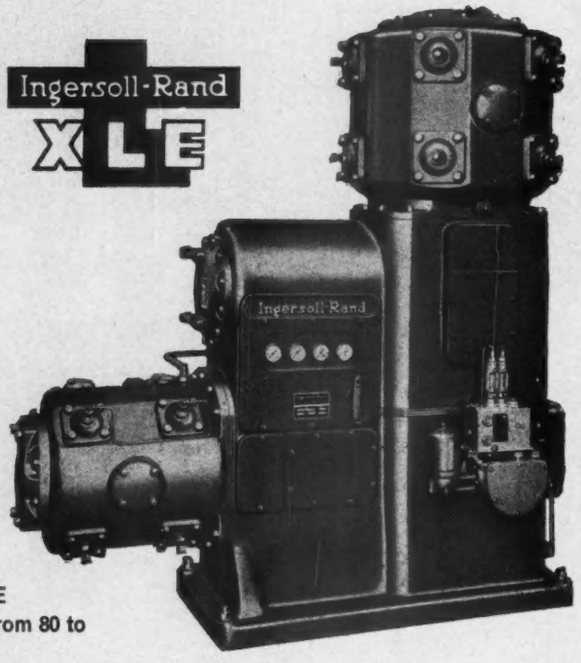

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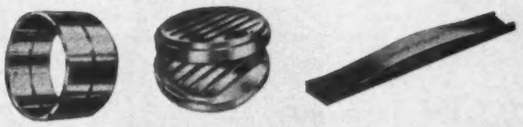

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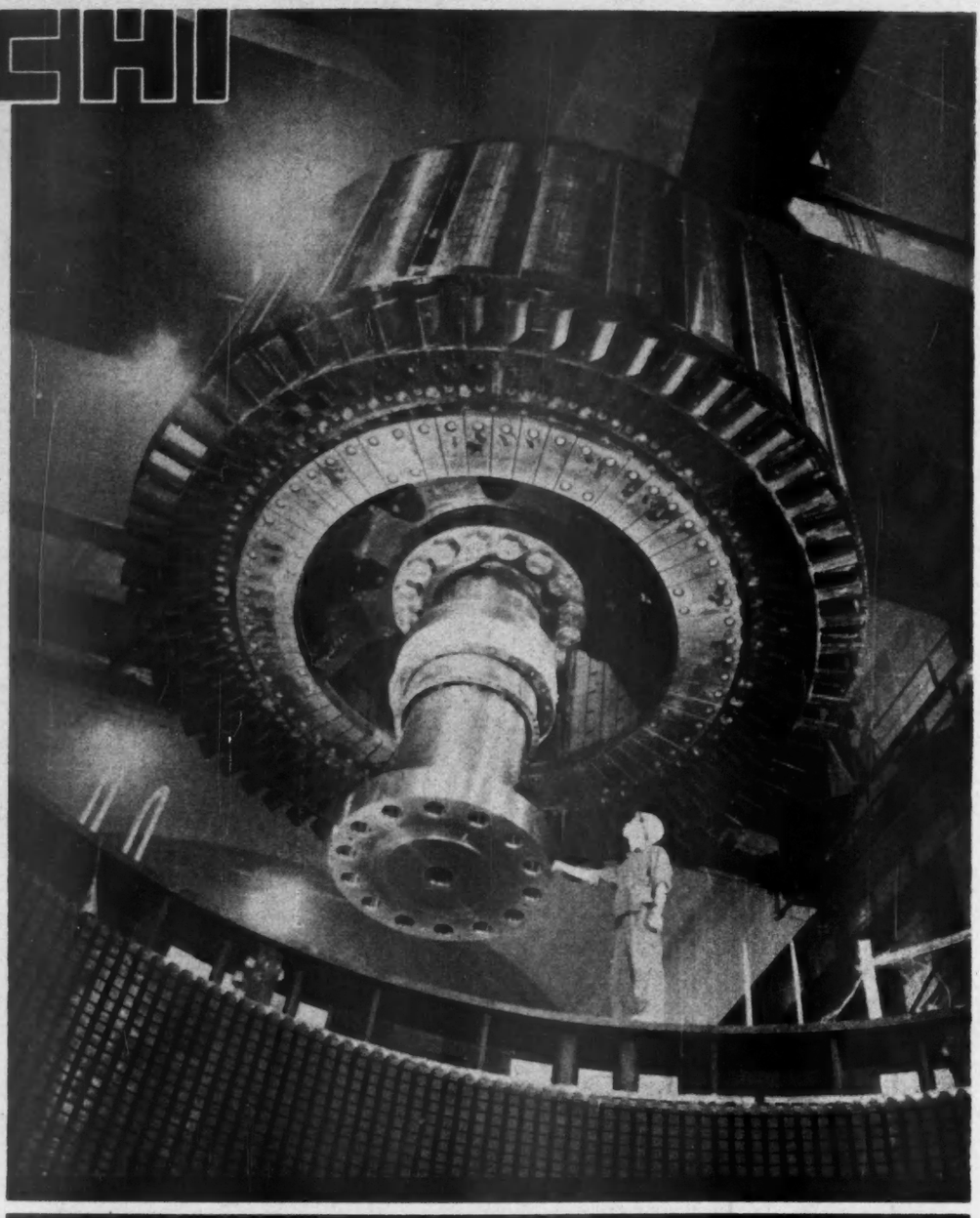

Hitachi has recently completed two 137,500kw/125,000VKA hydraulic turbines and generators for the Miboro Power Station in Central Japan. The turbine is of the vertical-shaft Francis type, and specified for a speed of 225rpm, a maximum effective head of 200m and 76.6 cu.m/sec. water flow, making it one of the largest units of its kind in the world. Its runner has a maximum diameter of 3.7m and the main shaft a diameter of 96cm. The spiral casing, which was constructed in 13 sections to facilitate transportation to the site, has an inlet diameter of 3.35m and an outer diameter of 11.2m.

The generator presents a high-torsoed appearance having been so designed in consideration of the comparatively high speed. Since the generator was designed for a rated voltage of 16,500 volts and, in this respect, represents the first such attempt in Japan, particular care was taken in the corona-shielding and impulse resistance of the stator winding. The generator is rated at 60 cycles, 225rpm and 0.9 power factor, but is also capable of operating at 50 cycles, 187.5rpm and 1.0 power factor.

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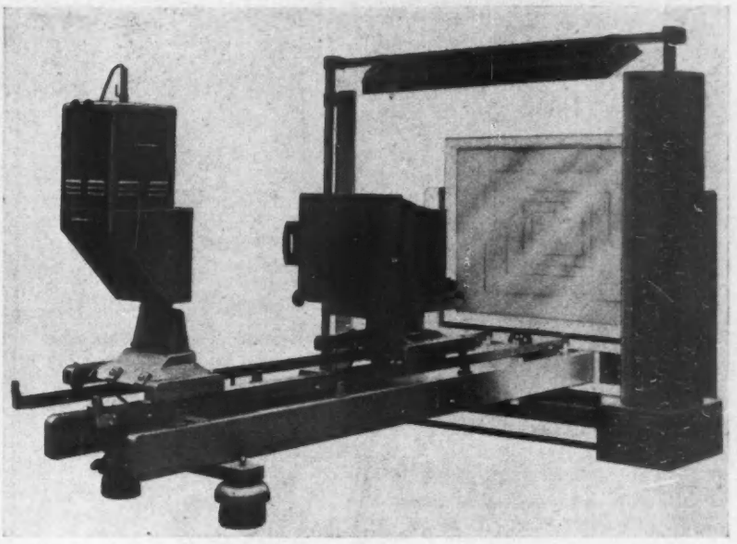

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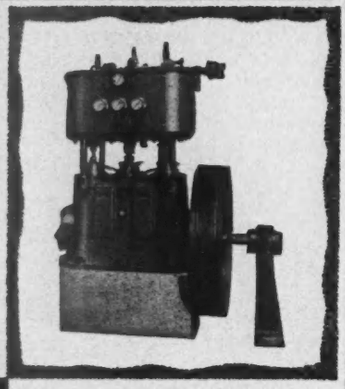

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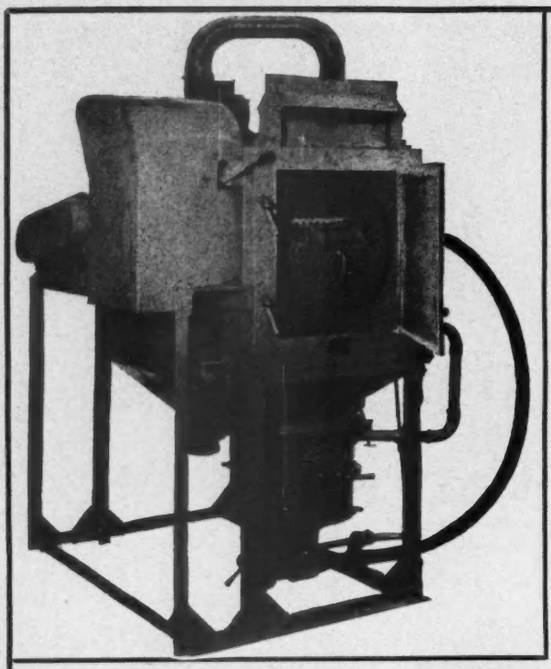

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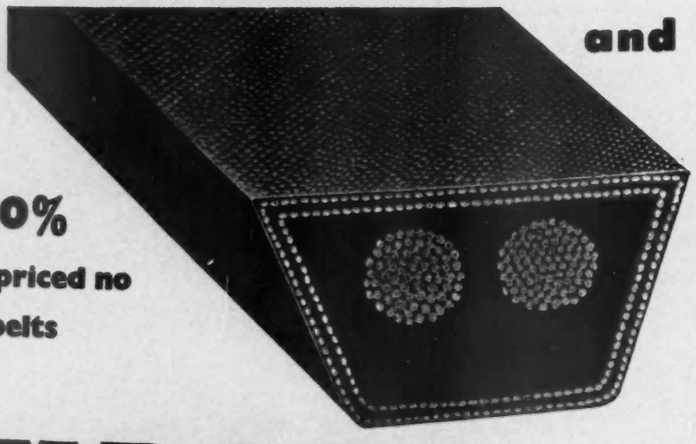
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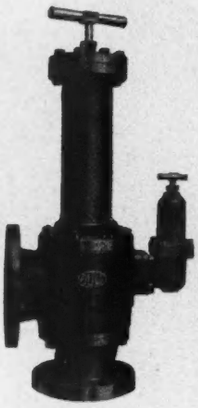

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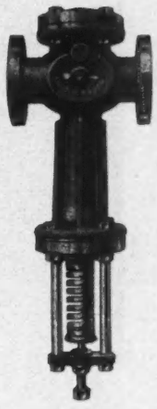

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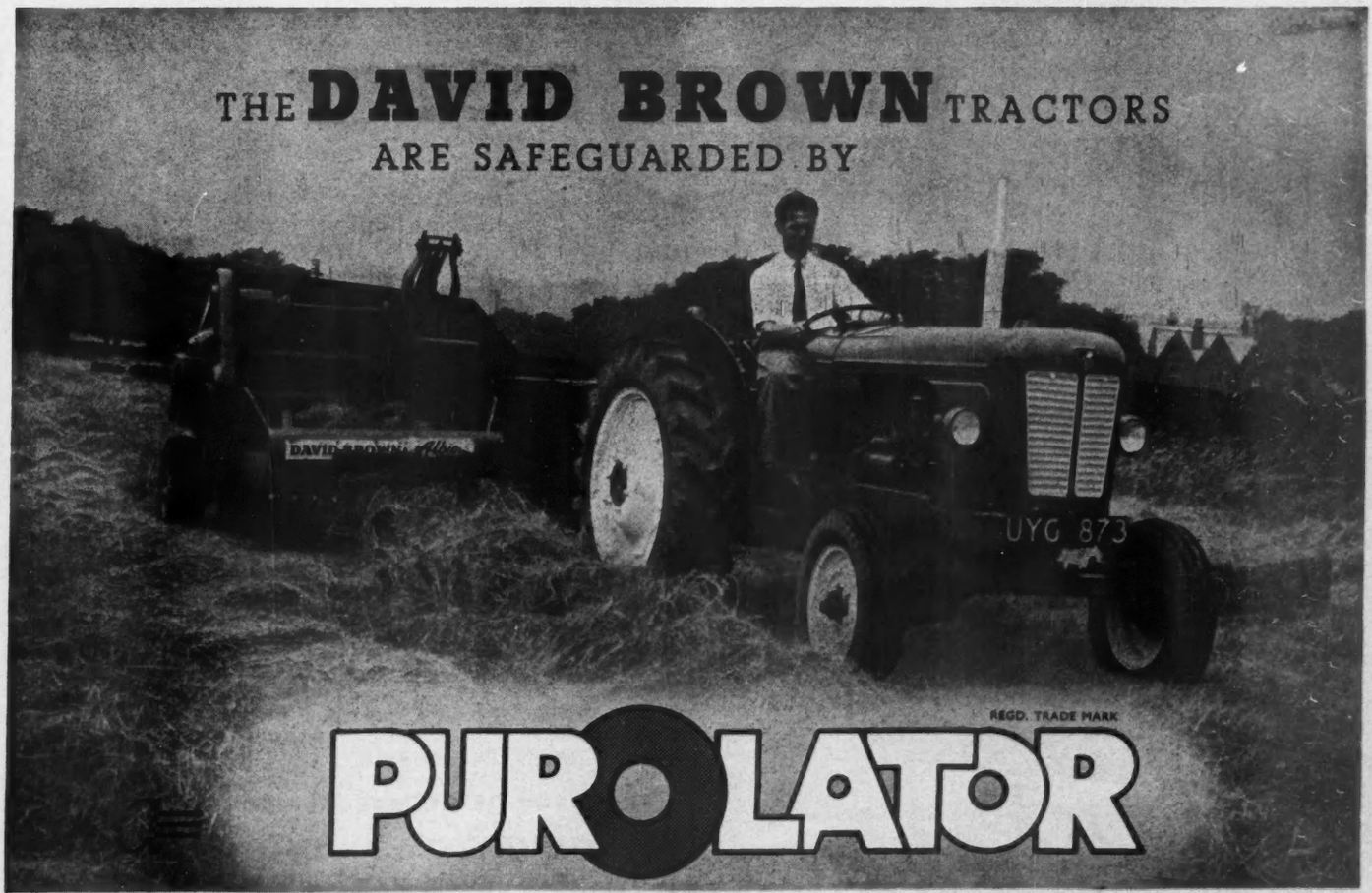

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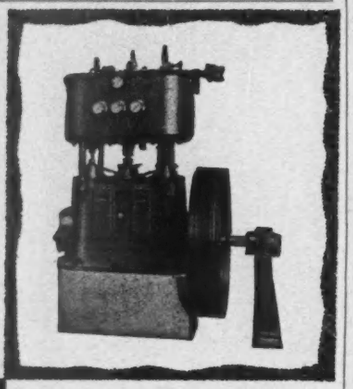

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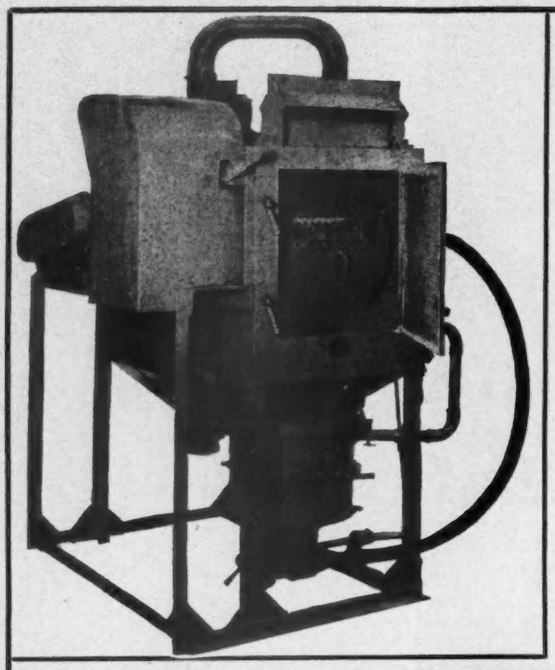

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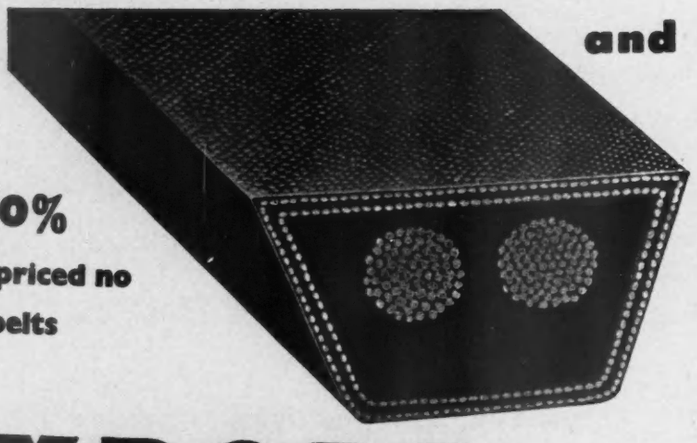

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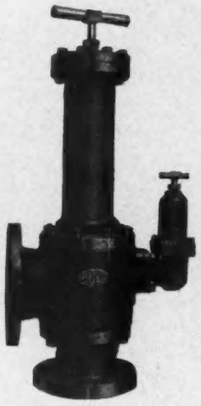

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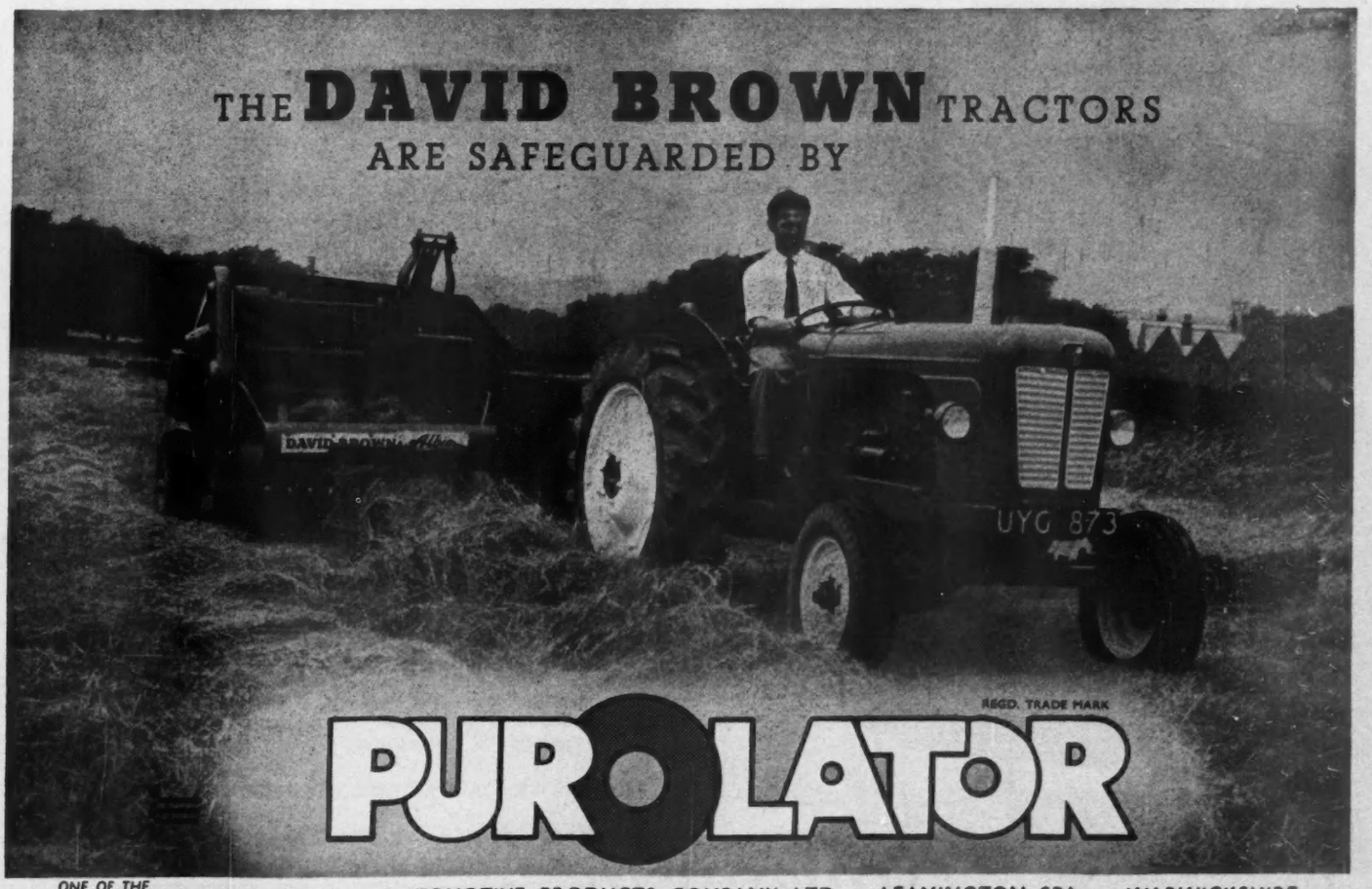

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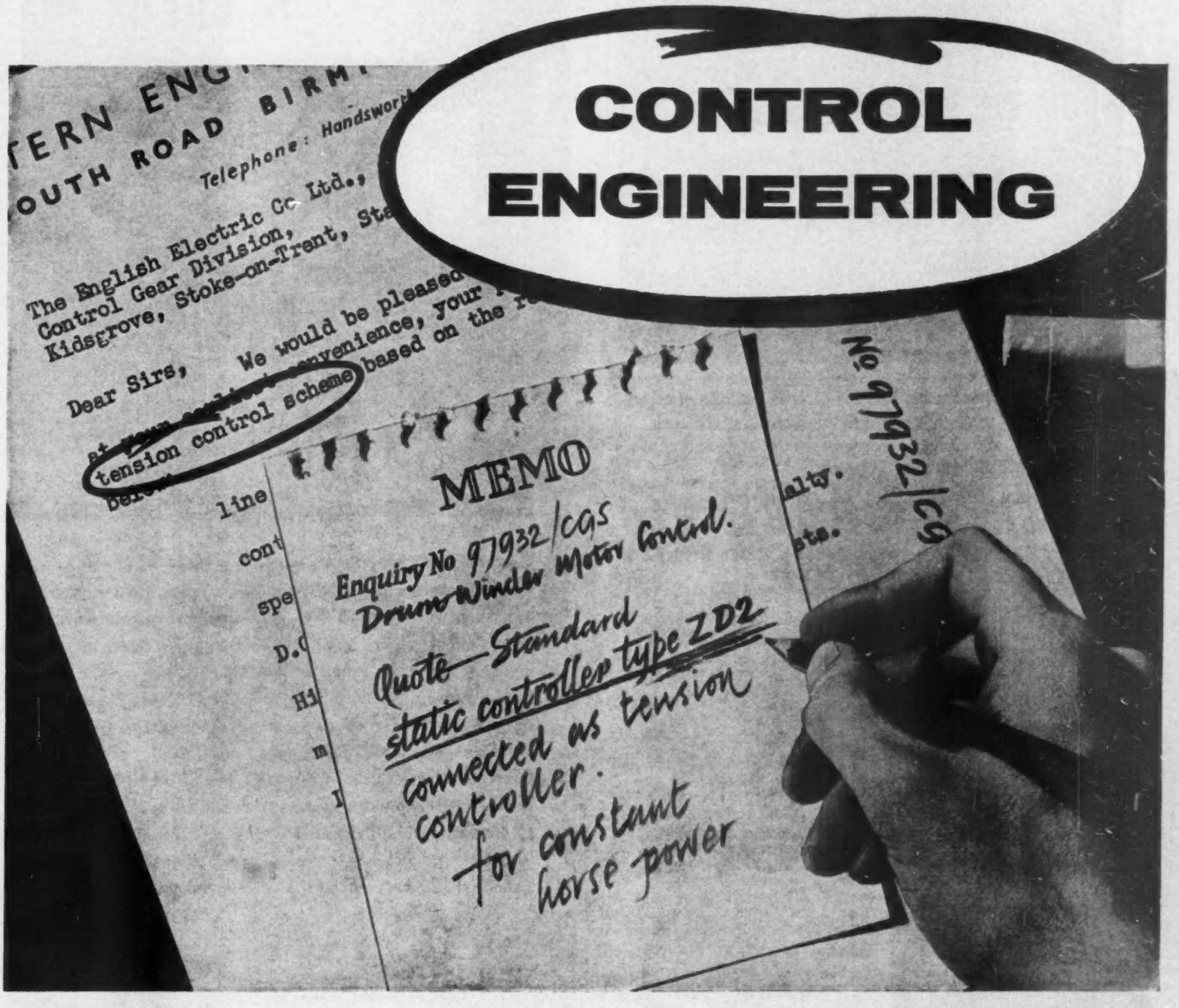

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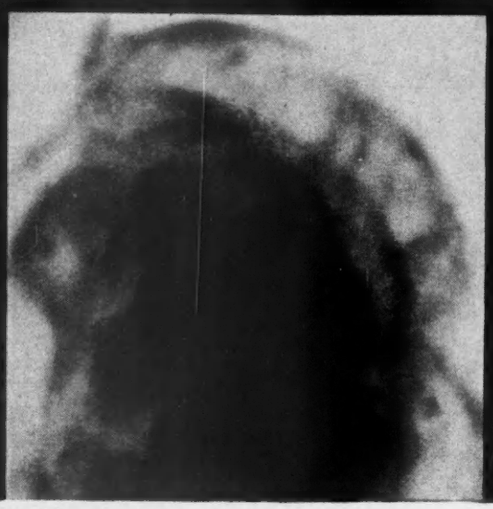

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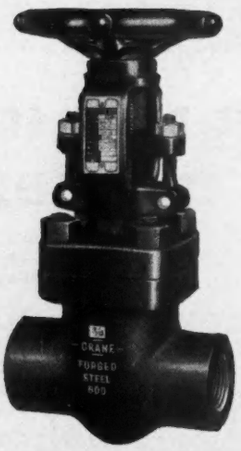

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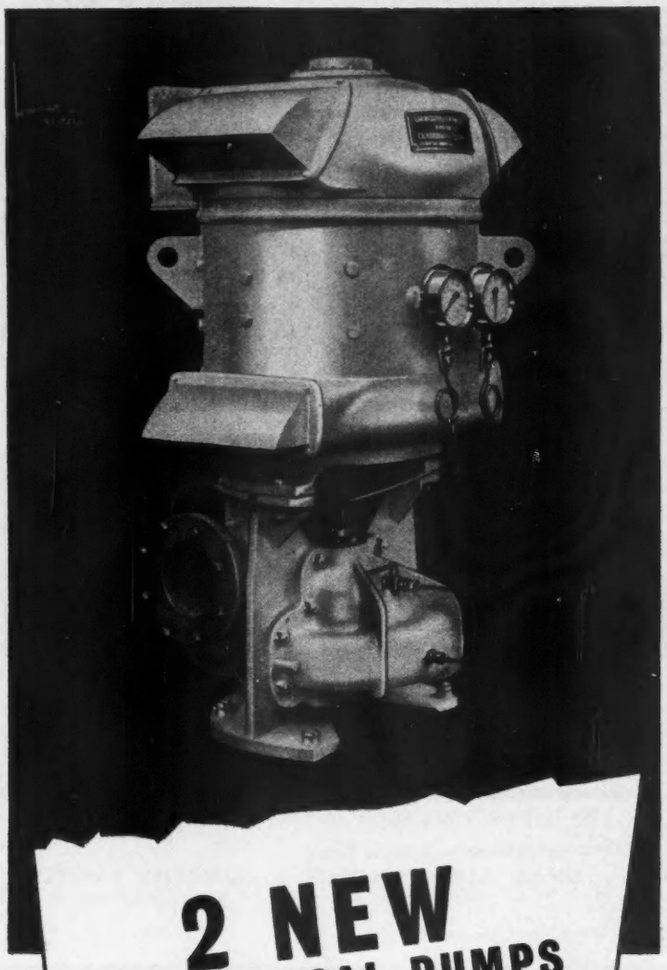

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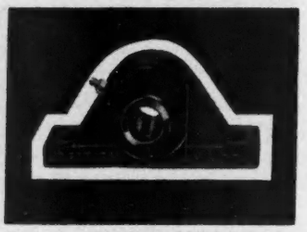

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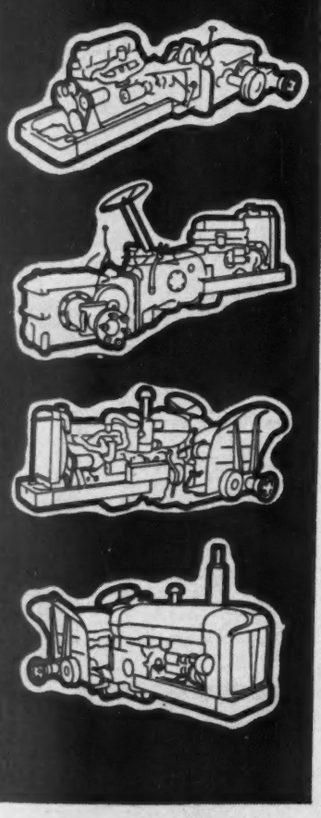

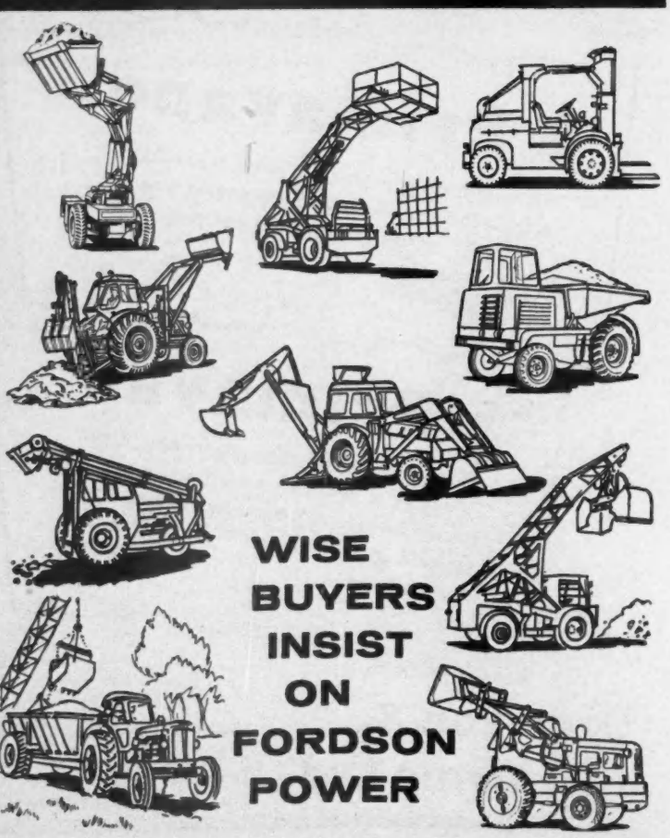

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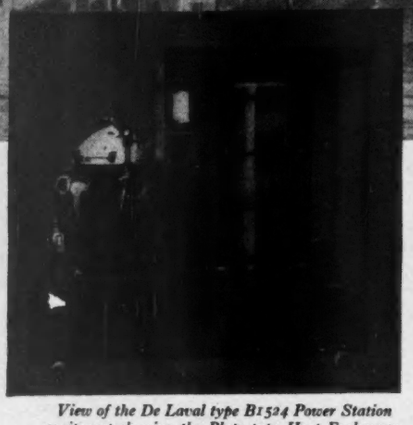

View of the De Laval type B1524 Power Station equipment showing the Plate type Heat Exchanger.

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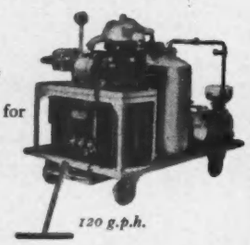
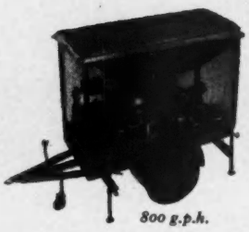


120 g.p.h.



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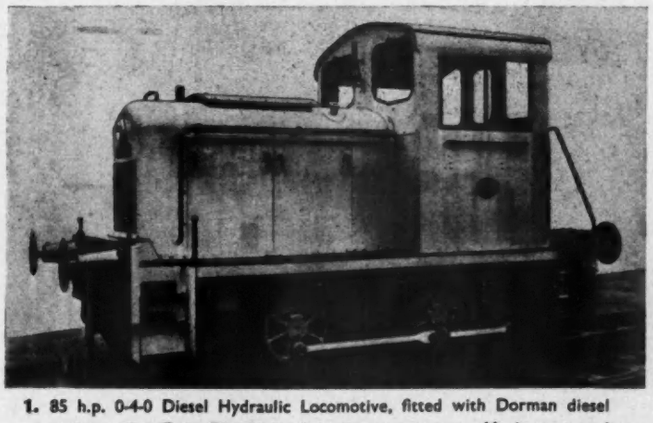

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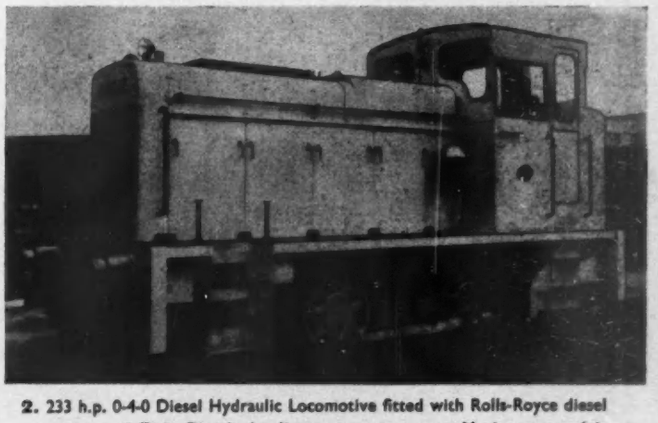

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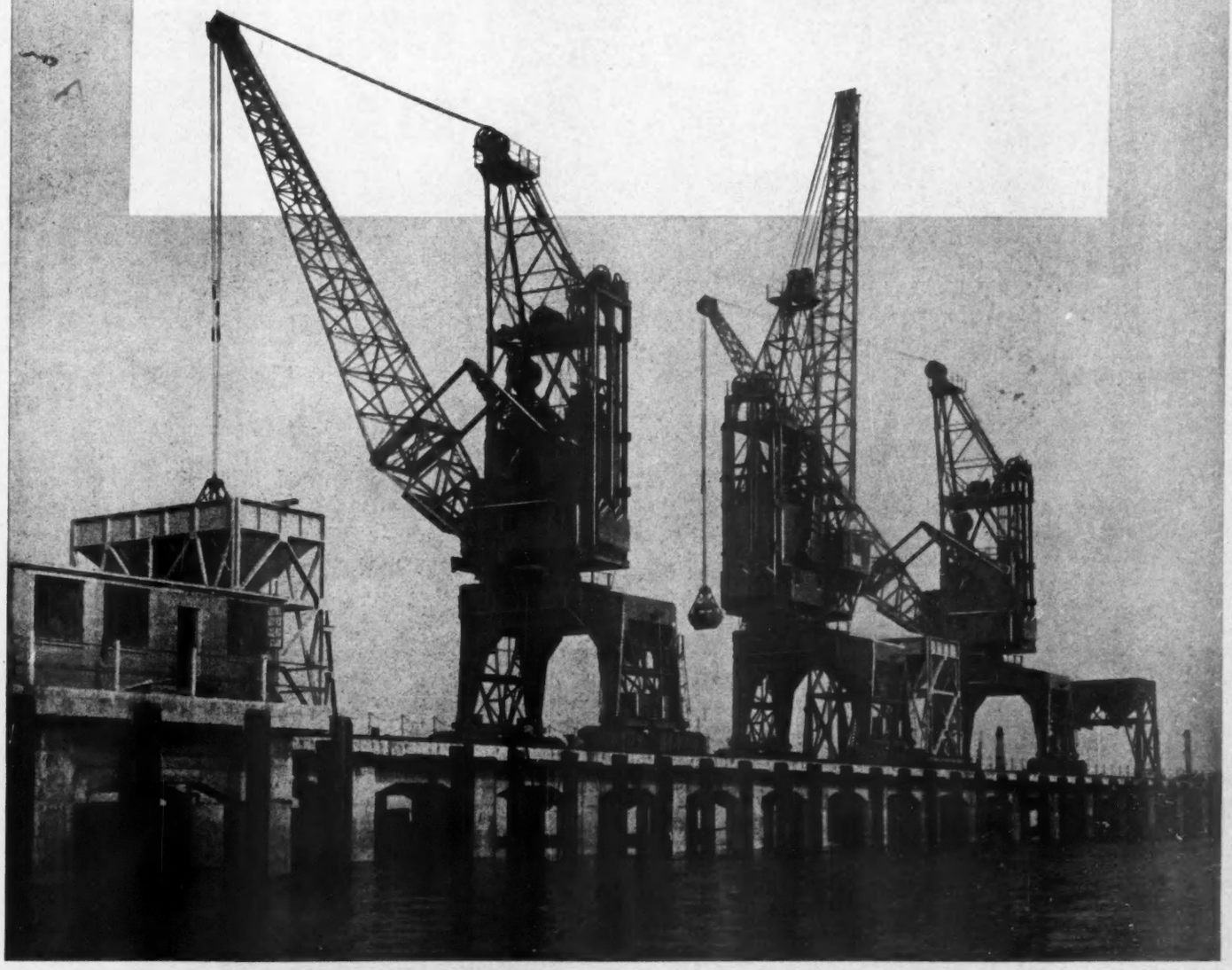

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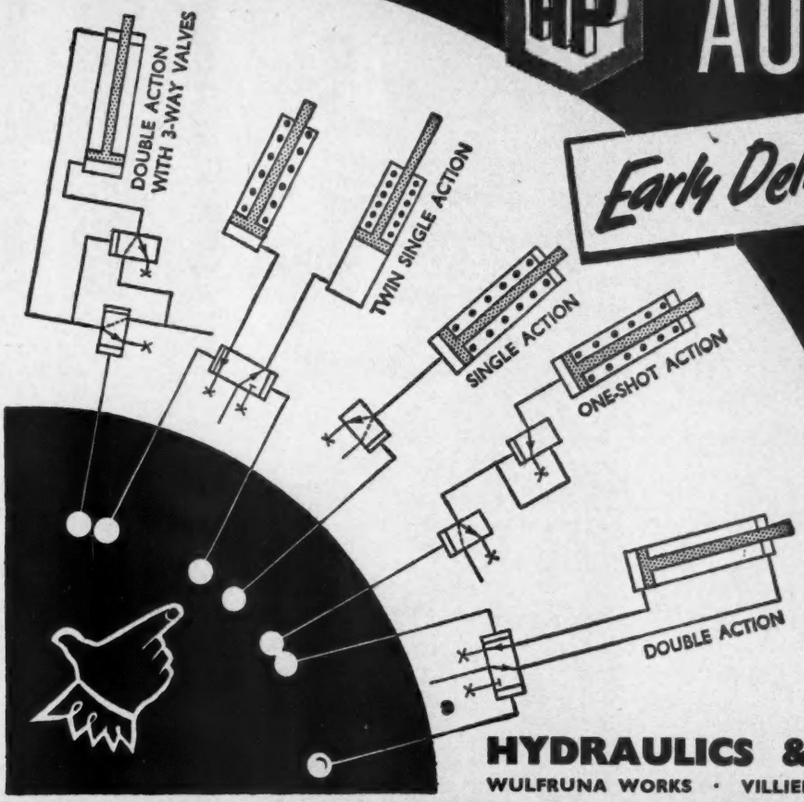

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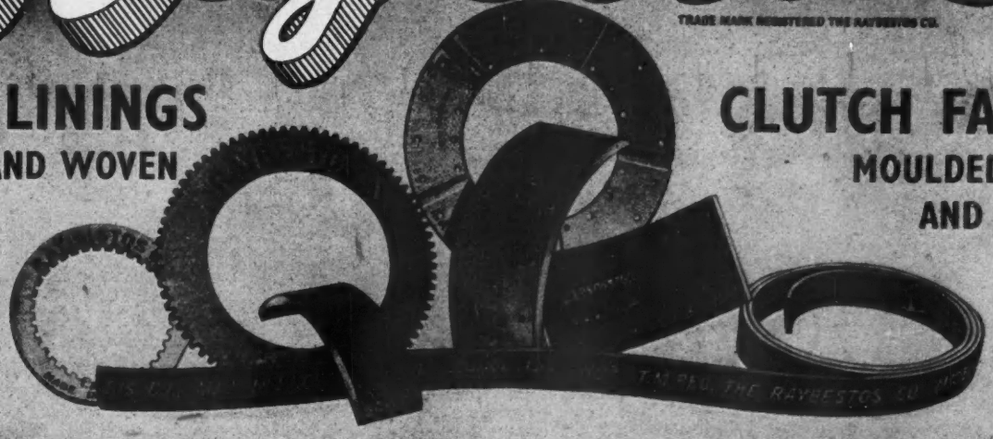

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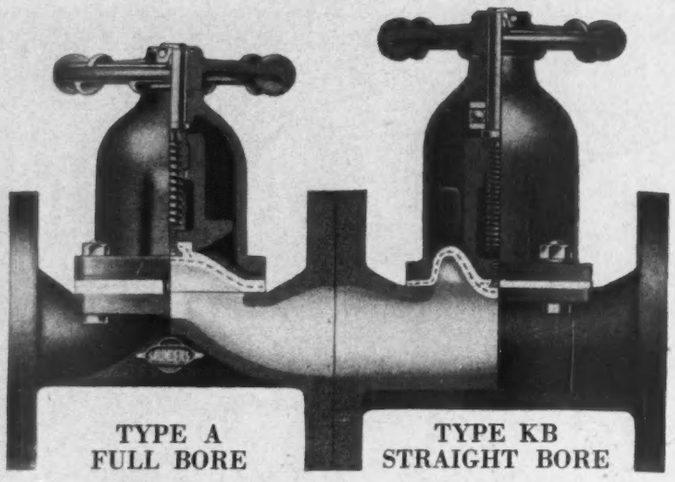

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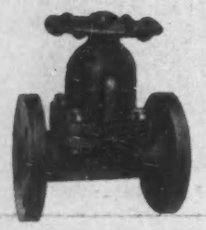

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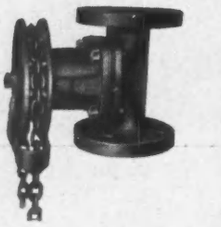

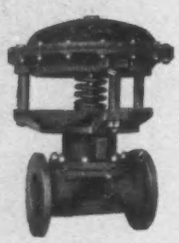

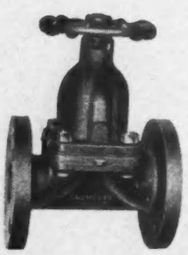

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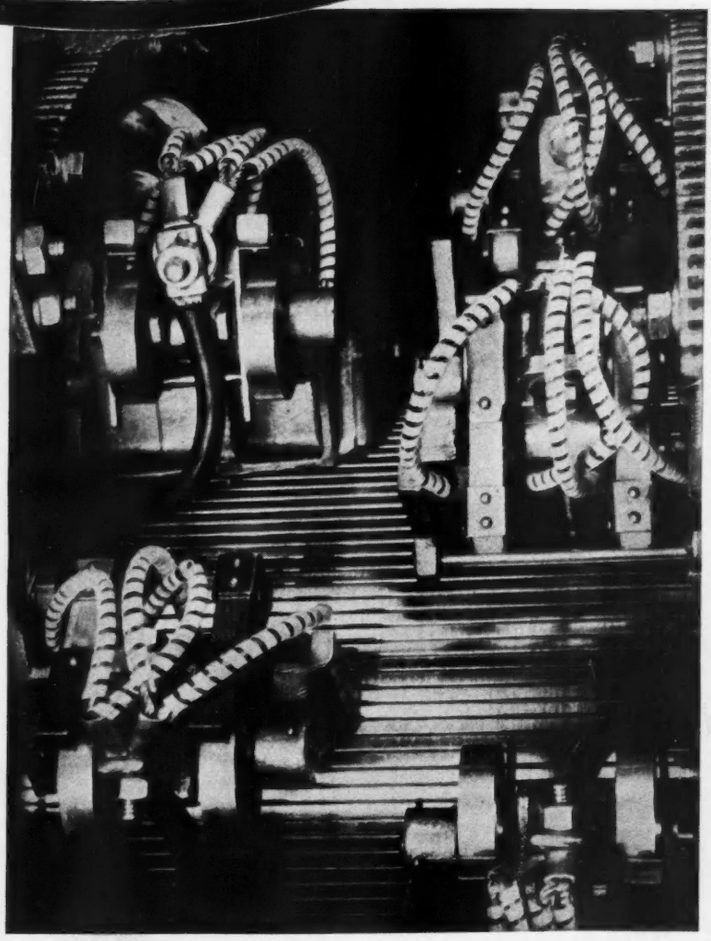
Self-contained
variable-speed
THREE-PHASE A.C. MOTORS



IMPORTANT ADVANTAGES

Speed

Stepless variation, with unlimited speed ratios. No external regulator. Wide speed range, with reverse operation when required. Speed variation may be by hand, remote or servo control.

High Performance

Good shunt characteristics at all speeds, whether motoring or generating. High efficiency and power factor throughout top half of speed range. High starting torque with low starting current.

Good Delivery

Motors up to 100 h.p. are built from stock parts ensuring short delivery times. Many sizes from 3 h.p. upwards available from stock.

Write for further information to:

(FOR MOTORS UP TO 30 H.P.)
Small Industrial Machines Sales,
Motor & Control Gear Division.
BLACKHEATH, STAFFS.

(FOR MOTORS ABOVE 30 H.P.)
Medium Electrical Machine Sales,
Heavy Plant Division,
RUGBY.

AEI

Associated Electrical Industries Limited

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